The New Zealand

Journal of Agriculture.

VOL. 50. WELLINGTON, 20TH JUNE, 1935. No. 6.

VERTICILLIUM-WILT OF POTATOES.

ITS RELATION TO STEM-END DISCOLORATION OF THE TUBERS, AND SUGGESTED MEASURES FOR CONTROL.

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IT has been demonstrated (Chamberlain, 1935, *b.*) that verticillium-wilt, caused by *Verticillium albo-atrum*, may, under New Zealand conditions, cause a considerable reduction in the yield of potato crops. Since the disease is carried in the tubers, it is inadvisable to use for seed purposes potatoes from a heavily infected crop. The necessity therefore arises for an efficient method of determining the percentage of wilt-infection. Two methods have been suggested—(1) counts of wilted plants in the crop during the growing season, and (2) the determination, after harvesting, of the percentage of tubers showing stem-end vascular discoloration.

FIELD COUNTS FOR THE DETERMINATION OF VERTICILLIUM-WILT.

Verticillium-wilt may cause wilting of the foliage at any time throughout the growing-season, so that to obtain the most reliable results it is necessary to make the field inspection as late as possible. Even counts taken late in the season, however, do not include all infected plants, for there is always a percentage which do not show any foliage symptoms. An experiment in which field counts were taken throughout the growing-season was carried out to ascertain the correlation between field symptoms and verticillium-wilt (Table 1). Wilt-infection was determined by means of cultures prepared from the vascular system of the stems, only those plants from which *V. albo-atrum* was isolated being classed as infected. At harvest, from each plant was selected one seed-size tuber from which, later, isolations were made from the vascular tissues at the stem-end. The technique adopted has been described in a previous article (Chamberlain, 1935, *a.*).

It has been shown that all the tubers of a wilted plant do not necessarily become infected with verticillium-wilt and that the disease may be present in tubers from apparently healthy plants (Pethybridge, 1916; McKay, 1921, 1926; Chamberlain, 1935, *b.*). It is evident, therefore, that the percentage of plants showing wilt-symptoms in the field does not give an absolute measure of the amount of tuber-infection

(Tables 1 and 2). Experiments (Table 2) have also shown that there is no constant relation between the percentage of wilt in the field and the percentage of tuber-infection.

Table 1.—The Correlation between Field Symptoms and Infection by V. albo-atrum.

Appearance of Plants in the Field.	Haulms.		Tubers.	
	Number.	Percentage infected.	Number.	Percentage infected.
Wilted	153	95	140	20
Slightly wilted ..	22	91	21	10
Leaves discoloured* ..	65	65	61	20
Healthy	275	11	255	9
Totals ..	515	46	477	13

* There were no symptoms of wilt on these plants and only some of the leaves were beginning to turn brown. Such plants would not be recorded as wilt-infected in field counts.

Table 2.—The Relation between Field Symptoms and Tuber-infection in Different Lines of Potatoes.

Appearance of Plants in the Field.	Aucklander Tall Top Potatoes grown at Palmerston North.			
	1930–31 Season.		1931–32 Season.	
	Number of Tubers.*	Percentage Infection.	Number of Tubers.*	Percentage Infection.
Wilted	101	52	161	19
Healthy	100	18	255	9
Totals ..	201	35	416	12·5

* The tubers were seed-size, each one being selected at harvest from the progeny of individual plants marked in the field during the growing-season.

The figures in the above table show that in both seasons tuber-infection is less than field counts suggest. They also show that the percentage infection of tubers from wilted plants was much greater in the 1930–31 season than in the 1931–32 season. It is possible that the difference may be explained on the grounds that the former crop was allowed to remain in the ground for some time after the haulms had died down, while the latter crop was lifted immediately the crop was mature.

CORRELATION BETWEEN STEM-END DISCOLORATION AND VERTICILLIUM-WILT INFECTION OF THE TUBERS.

Elsewhere it would appear that there is little, if any, correlation between vascular discoloration at the stem-end of potato-tubers and the presence of wilt-producing organisms. Thus Pethybridge (1916), working with verticillium-wilt in Ireland, found that tubers might be infected with the disease, although they showed no stem-end discoloration. In North America Edson (1920), McKay (1921, 1926), and Eastham (1923) showed conclusively that the presence or absence of *V. albo-atrum* in the tubers could not be determined by the presence or absence of vascular discoloration at their stem-ends. Since the cause of vascular discoloration under New Zealand conditions was unknown, the following experiments were undertaken to determine whether there was any correlation between stem-end discoloration and verticillium-wilt infection.

The first experiments were carried out with tubers from a commercial line of Aucklander Tall Top potatoes which had shown a high percentage of wilt in the field. The crop was grown, during the 1929–30 season, in the Rangiora district, and the progeny, grown the following year at Palmerston North, supplied the seed for the 1931–32 season. The other varieties were grown in various localities (Table 3). The correlation between stem-end discoloration and verticillium-wilt infection of the tubers of different lines of potatoes grown in different localities may be seen from the following table.

Table 3.—Showing Correlation between Stem-end Discoloration and Verticillium-wilt Infection of Tubers of Different Lines of Potatoes.

Variety.	Locality grown.	Year.	Extent of Stem-end Discoloration.	Number of Tubers.	Number of Tubers yielding			Percentage of Tubers yielding *V. albo-atrum.*
					Verticillium albo-atrum.	Other Fungous Species.	No Growth.	
Aucklander Tall Top	Rangiora ..	1929–30	Extensive	65	25	39	1	38
			Slight ..	82	8	67	7	10
			None ..	17	1	3	13	6
Aucklander Tall Top	Palmerston N. ..	1930–31	Extensive	61	24	33	4	39
			Slight ..	79	13	42	24	16
			None ..	14	..	1	13	0
Wilted Plants.								
Aucklander Tall Top	Palmerston N. ..	1930–31	Extensive	53	27	26	..	51
			Slight ..	47	25	19	3	53
			None ..	1	..	1	..	0
Healthy Plants.								
Aucklander Tall Top	Palmerston N. ..	1930–31	Extensive	23	13	9	1	56
			Slight ..	61	5	41	15	8
			None ..	16	..	7	9	0
Wilted Plants.								
Aucklander Tall Top	Palmerston N. ..	1931–32	Extensive	57	9	48	..	16
			Slight ..	79	19	55	5	24
			None ..	12	..	2	10	0
Healthy Plants.								
Aucklander Tall Top	Palmerston N. ..	1931–32	Extensive	39	9	29	1	23
			Slight ..	199	25	118	56	13
			None ..	78	2	14	62	3

Table 3—continued.

Variety.	Locality grown.	Year.	Extent of Stem-end Discoloration.	Number of Tubers.	Number of Tubers yielding			Percentage of Tubers yielding *V. albo-atrum.*
					Verticillium albo-atrum.	Other Fungous Species.	No Growth.	
Epicure	Palmerston N. ..	1930–31	Extensive	18	4	10	4	22
			Slight ..	136	8	59	69	6
			None ..	97	4	4	89	4
New Era ..	Ashburton ..	1930–31	Extensive	24	..	14	10	0
			Slight ..	1	..	..	1	0
			None ..	..	..	..	..	0
Wilted Plants.								
King Edward* ..	Gore	1932–33	Extensive	39	1	37	1	3
			Slight ..	53	..	48	5	0
			None ..	4	..	1	3	0
Healthy Plants.								
King Edward* ..	Gore	1932–33	Extensive	39	..	35	4	0
			Slight ..	51	..	43	8	0
			None ..	4	..	1	3	0
Wilted Plants.								
Arran Chief* ..	Gore	1932–33	Extensive	33	..	18	15	0
			Slight ..	51	..	21	30	0
			None ..	12	..	..	12	0
Healthy Plants.								
Arran Chief* ..	Gore	1932–33	Extensive	28	..	17	11	0
			Slight ..	50	..	16	34	0
			None ..	19	..	1	18	0
Dakota	Weedons ..	1933–34	Extensive	4	..	..	4	0
			Slight ..	..	..	..	..	..
			None ..	..	..	..	..	..
Dakota	West Melton ..	1933–34	Extensive	4	..	..	4	0
			Slight ..	..	..	..	..	..
			None ..	..	..	..	..	..

* In crops of King Edward and Arran Chief potatoes grown at the Gore Experimental Farm during the 1933–34 season plants in certain areas wilted. The tubers used in this experiment were selected from wilted and healthy plants respectively. The wilting was apparently not associated with verticillium-wilt, and the progeny of the wilted plants produced a healthy crop in the following season.

A study of Table 3 shows that there is a certain amount of correlation between vascular discoloration and verticillium-wilt in some lines of potatoes. In others, however, there is no such correlation, verticillium-wilt being entirely absent from certain lines showing a high percentage of tubers with stem-end discoloration.

The New Era and Dakota potatoes showed a very distinct discoloration of the whole vascular system of the tuber (figs. 1 and 2). The progeny of the New Era potatoes when grown in Palmerston North during the 1931–32 season did not develop any vascular discoloration. In the case of the Dakota tubers from Weedons the grower stated that the trouble resulted from flooding of the field prior to harvesting. Potatoes from the same crop, harvested before flooding, showed no signs of the discoloration. This supports the view of Edson (1920) and Goss (1923)

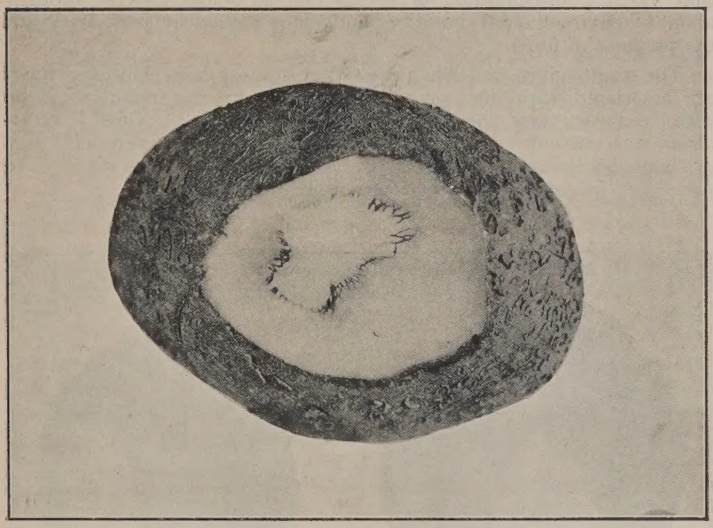

FIG. 1. VASCULAR DISCOLORATION AT STEM-END OF TUBER.
New Era potato tuber in which no fungus was associated with the discoloration.

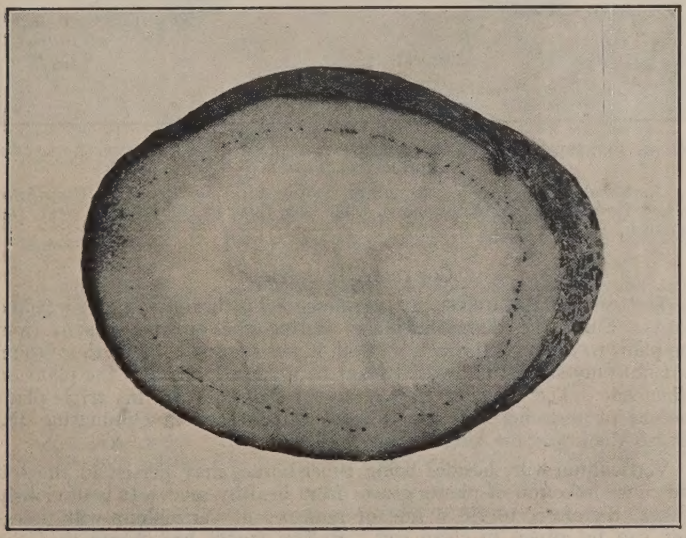

FIG. 2.—VASCULAR DISCOLORATION EXTENDING INTO TUBER.
Same tuber as in Fig. 1, cut transversely mid-way between stem and rose ends.

that vascular discoloration of tubers may in some cases be brought about by environmental conditions and is not necessarily associated with the presence of fungi.

The results given in Table 3 show that in most cases, however, fungi are associated with discoloured tissues. No specific fungus could be correlated with any particular type of discoloration. Thus *V. albo-atrum* was isolated from tubers showing dark or light brown, extensive or slight discoloration, and from tubers showing no discoloration. The same may be said of the other fungi isolated. (See fig. 3.)

FIG. 3. DIFFERENT FUNGUS SPECIES ASSOCIATED WITH SIMILAR TYPES OF STEM-END DISCOLORATION.

Aucklander Tall Top potato tubers. From tuber on left both *Penicillium* sp. and *Verticillopsis* sp. were isolated, while from tuber on right *V. albo-atrum* was obtained.

Control Measures.

The control measure usually recommended is that of rogueing infected plants. Since the disease spreads, during the growing-season, from one plant to the next through the soil, it was suggested by Jardine (1922) that not only should the wilted plant be removed, but also the plant on either side. The work of McKay (1926) showed that this triple-plant method of rogueing was much more satisfactory in eliminating the disease than was the single-plant method.

Verticillium-wilt, besides being tuber-borne, may persist in the soil and cause infection of plants grown from healthy seed. It is obviously useless, therefore, to rid a line of potatoes of verticillium-wilt unless they can be grown in clean soil. McKay (1926) has shown that the fungus may live in old potato-tops from one season to the next, but

that it will not survive two seasons. He found, however, in field-crop-rotation trials that at least three years were necessary to eliminate completely the disease from the soil.

The system of potato-seed-certification in operation in New Zealand has reduced the amount of verticillium-wilt occurring in commercial crops, and there has been a marked improvement in the three most susceptible varieties—Aucklander Tall Top, Aucklander Short Top, and Up-to-Date.

Where an otherwise healthy line of potatoes is infected with verticillium-wilt the grower should plant his seed-block* on clean land (that is, land which has not grown potatoes or tomatoes for three or four years). In this block infected plants should be rogued by the triple-plant method. A crop-rotation of at least three years should be practised with the main block.

Summary.

(1) Counts of wilted plants in the field is the most reliable method for determining the amount of verticillium-wilt in a crop, but does not give an absolute figure for the percentage of tuber infection.

(2) Stem-end vascular discoloration should not be used to determine the percentage of the disease in a line of potatoes, since there is little correlation between stem-end discoloration and the presence of verticillium-wilt.

(3) Suggested control-measures are three or four year crop rotation and the rogueing of infected plants, together with those plants on either side.

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* By seed-block is meant an area of potatoes where rogueing and selection may be carried out for improving the line. The block should be large enough to meet the grower's seed-requirements for the following year.

The Orchard Instructor, Dunedin, reports that the youngberry has been fruited in Roxburgh. In growth this berry somewhat resembles the thimbleberry, but the fruit is larger and it is not such a rampant grower. The fruit, which was ripe during the first week in January, is black, about 1½ in. long, and not so even in outline as the thimbleberry, being more swollen in the centre while retaining a cylindrical shape. The flavour is good, and it promises to be a good cropper, but its resemblance to a very vigorous blackberry is too great to give it an unqualified recommendation.

"CROSS 7" WHEAT.

A NEW COMBINATION OF HIGH YIELD AND BAKING-QUALITY.

WHEAT RESEARCH INSTITUTE, Christchurch.

(This report contains sections of interest to farmers taken from a more complete report written by Dr. O. H. Frankel, Plant Geneticist to the Wheat Research Institute, and published as Bulletin No. 48 of the Department of Scientific and Industrial Research. The bulletin contains details of distensometer and fermentation tests, and analyses of the factors determining yield in both the cross and its parents.)

THE predominant wheat grown in New Zealand in recent years has been Tuscan, a wheat probably of Mediterranean origin, which possesses characteristics that render it very suitable over a wide range of soils and climates in the Dominion. Varieties such as Hunters and Pearl have also been grown to a lesser extent, and these three names represent the main groupings of New Zealand wheat in commercial circles to-day.

While Tuscan is one of the best-yielding wheats under New Zealand conditions, its baking-quality is not equal to that of the spring wheats of Canada, nor to that of the wheats from the drier parts of Australia. There has been, therefore, a more or less regular annual import of about 500,000 bushels of Canadian and Australian wheats (flour being counted as wheat) for the purpose of blending these with New Zealand wheats in order to improve the baking-quality of the resultant flour. Hence there has always been a desire to breed a variety of wheat which would yield well under New Zealand conditions, and which would yet be of sufficiently improved quality to obviate the necessity of importing foreign wheats. The impetus in this direction gained force from the success which had attended efforts in the same direction overseas, especially in the production of Yeoman by Sir R. H. Biffen at Cambridge.

The problem of breeding a wheat suitable for our New Zealand conditions constitutes a difficult task. In the first place, the high average yield of New Zealand wheat is due very largely to the high average yield of the predominating variety Tuscan. It must always be borne carefully in mind that yield per acre, in general, constitutes the all-important characteristic from the wheatgrowers' point of view. It is this quality of Tuscan which has placed it in higher favour with New Zealand farmers than the lower-yielding but higher-quality Pearl and Hunters varieties. Tuscan, moreover, has fully demonstrated that it is better able than any other wheat to withstand the wind losses which constitute the most serious menace in the chief wheatgrowing districts of the Dominion. Again, it is one of the most tolerant wheats as regards soil, time of sowing, and resistance to frost, dry conditions, and diseases. A combination of all these and other factors has rendered Tuscan a most popular variety from the growers' point of view, although it did not completely satisfy either the miller or the baker through

its lack of other qualities. Whoever would attempt to produce a variety which would be an improvement on Tuscan was faced, therefore, with the difficulties of producing a wheat—

(1) Which would give a yield per acre either equal to or greater than Tuscan:
(2) That would not only withstand wind damage, but all the other vicissitudes of a crop growing in a wide range of soils and climate:
(3) Which would possess a flour-yield and a baking-quality approaching that of the best varieties grown in Canada and Australia.

With these objects in view, a number of crosses between high-yielding New Zealand wheats and high-quality foreign wheats was made at Canterbury Agricultural College in 1923. From 1925 till 1929 (F_2 to F_5) single plants were selected amongst those hybrid families which on eye-judgment were selected for yielding-capacity and grain-quality. When in 1929 the Wheat Research Institute was formed, 165 lines selected from this hybrid material were handed over by the College to the Plant-breeding Station of the Institute, which was established at the College. A rod-row yield trial in 1929–30, consisting of single row plots, every fourth plot a standard plot (Solid-straw Tuscan), with ten replications, reduced the number of lines to fifteen, all of which belonged to Cross 7 (White Fife × Solid-straw Tuscan). For the last four seasons a steadily decreasing number of these lines were tested in field trials at the Plant-breeding Station of the Institute, and at an ever-growing number of localities distributed over the wheatgrowing districts. During the last season (1933–34) only one line, 7·03 (now called "Cross 7") was retained. The method applied in these field trials was either Hudson's modification of Beaven's half-drill-strip method, or, in many trials of the last season, Beaven's original method, all with ten replications.

The trials at Lincoln were conducted by the Wheat Research Institute in co-operation with Lincoln College. All other district trials were arranged by the Fields Division of the Department of Agriculture in collaboration with the Institute. These trials were conducted on a co-operative basis with the farmers on whose land they were situated.

The tests for milling and baking quality were carried out at the Chemical Laboratory of the Wheat Research Institute.

During the period of testing, a supply of pure seed was built up as the result of co-operation between the Wheat Research Institute and the Pure Seed Station of the New Zealand Department of Agriculture.

Description of Cross 7.

In the early stages of growth, Cross 7 closely resembles Solid-straw Tuscan, its growth type being strongly erect and its rate of tiller-production low. From the start of growth in the early spring, Tuscan leads in height, this difference being maintained through all growth stages. Heading takes place from two to four days ahead of Tuscan. Between heading and ripening, the leaves and stems of Cross 7 are more erect than those of Tuscan. This has the effect of making a crop of Cross 7 appear thin, although counts of heads prove the contrary. For this reason eye-judgment

of Tuscan and Cross 7 in comparative trials nearly always favours Tuscan, even in those trials where Cross 7 scores a heavy surplus yield over Tuscan. From heading until the disappearance of green

FIG. 1.

Typical heads and grains of Tuscan (*a*), Cross 7 (*b*), and White Fife (*c*).

colour from the ear, Cross 7 can be easily distinguished from Tuscan by the lighter colour of its heads, a characteristic derived from the Canadian parent. In Tuscan the colour of the heads is throughout

similar to that of the leaves, whereas the Cross 7 ears are markedly paler. Cross 7 matures from two to six days ahead of Tuscan.

The mature plant of Cross 7 is similar to that of Tuscan. Its height is characteristically shorter from 2 in. to 6 in.; the head is slightly shorter and denser, the glumes smaller, the awn-tips shorter and thinner, the grain white, slightly smaller, but of a similar elongated shape, and somewhat finer in appearance. The straw, like that of Tuscan, is semi-solid.

According to the experience of five years' cultivation, Cross 7 equals Tuscan in its resistance to shedding of grain by wind, although apparently its threshing is easier. Many reports on experiments in 1933–34 recorded severe winds on dead-ripe crops without a single case of losses heavier than those of Tuscan.

Cross 7 is distinctly more resistant to lodging than Tuscan. The season 1933–34 with its heavy rainfall in South Canterbury taxed the standing-capacity of any variety to the utmost. In a very tall and heavy crop at Morven, Cross 7 showed no inclination to lodging, Tuscan was badly laid, while Hunters and Dreadnought showed marked signs of lodging. Similar observations were made wherever there was a danger of flattening crops. There is no case on record of bad lodging in Cross 7, even when Tuscan alongside was flattened out.

Observations on the occurrence of "straw-break," an affliction of Tuscan which is causing heavy losses in some localities, showed that Cross 7 is less affected than Tuscan. In a trial in 1933–34, situated on the Springfield Estate, Methven, the Tuscan plots were affected as badly as most crops in the district, whereas Cross 7 showed only few broken straws. The yield difference of 4·8 bushels in favour of Cross 7 in that trial is, more likely than not, largely due to this factor. Whenever there was "straw-break" in experimental areas, in North Canterbury as well as in Mid-Canterbury, a similar resistance was observed.

Whereas in the occurrence of rusts no difference was noticed between Tuscan and the new variety, the latter seems to be more susceptible to loose smut. If this is confirmed, a more frequent use of hot-water-treated smut-free seed will be necessary than has been the case with Tuscan.

Yield Performance of Cross 7.

Results from thirty-six yield trials contained in the table which follows record tests of five seasons. During the last two years Cross 7 has been tried out under very different conditions of soil, climate, and management. It has been the aim to choose localities as representative as possible of their districts.

Since Cross 7 is designed to serve as a higher-quality wheat to be grown in the Tuscan area, the districts in which this variety predominates have been particularly chosen for experiments. In some districts considerations of staff and expenditure have necessitated a smaller number of trials than had appeared desirable. On the whole, the experiments of the last two seasons are well representative of a large proportion of the wheatgrowing area, and the results of the three previous years add additional weight.

If this attempt at fair representation and the large number of individual trials render permissible a combination of the results, the following summary is obtained. Only thirty-four trials are summarized two being omitted—viz., (1) Tuamarina, where Cross 7

outyielded Tuscan by 15 bushels per acre, a result probably due to frosting of the Tuscan, and (2) Pukeuri B, which was on the same field as Pukeuri A.

Higher yields of Tuscan in twenty-two trials; of these eight are statistically significant.
Higher yields of Cross 7 in eleven trials; of these six are statistically significant.
Equal yields in one trial.
Taking these thirty-four trials, but omitting the rod-row trials of 1930–31—where the yields could not be expressed in bushels per acre—we have, as the mean of thirty-three trials,—

Mean yield of Cross 7 = 37·00 bushels per acre.
Mean yield of Tuscan = 37·84 bushels per acre.
Difference, Tuscan to Cross 7 = 0·84 bushels per acre.

Performance of Cross 7 in Comparative Trials with Solid-straw Tuscan, 1929–30 to 1933–34.

Yield Differences with Statistical Significance in Heavy Type.

Season.	Locality.	Yield, Bushels per Acre. (1929–30: Grammes per Plot.)		Flour Extraction: Per Cent. Flour.		Baking Score: 40 = Very Good.	
		Cross 7.	Difference from Tuscan.	Cross 7.	Tuscan.	Cross 7.	Tuscan.
1929–30	Lincoln	360 (1)	−14 (1)	..	..	..	..
1930–31	Lincoln	51·1	− 4·4	74·9	69·1	32·0	24·5
1931–32	Darfield	22·7(2)	+ 0·7	76·0	72·7	34·0	23·0
	Lincoln	70·7	+ 1·1	77·3	70·9	34·5	42·5
1932–33	Glasnevin ..	22·5	+ 1·8	71·6	68·6	38·5	37·5
	Rangiora	37·8	− 2·5	72·3	71·3	35·0	23·5
	Darfield	32·9	− **2·7**	71·7	70·8	38·5	28·0
	Lincoln	88·5	− 0·5	72·0	71·5	37·0	31·5
	Wakanui	57·5	− **3·9**	72·5	68·4	35·0	21·0
	Timaru	28·5	− 0·6	72·3	72·8	32·5	26·0
1933–34	Tuamarina ..	59·1(3)	+15·7(3)	71·0	68·5	17·0	11·0
	Omaka (Marlborough)	31·4(3)	− 0·9(3)	71·5	70·8	26·0	16·0
	Cheviot	49·7	− **6·3**(4)	72·2	71·0	28·0	18·0
	Culverden	23·6	+ 2·4(5)	73·0	72·2	34·0	30·0
	Glasnevin ..	10·7	− 0·5	72·4	67·6	28·0	27·0
	Amberley	21·8	− 2·4	72·4	69·6	19·0	15·0
	Rangiora	46·9	− 0·7(6)	73·4	73·2	40·0	25·0
	Fernside	21·8	− 5·8	71·8	71·2	33·0	28·0
	Springbank ..	28·8	+ 0·7	71·6	69·2	27·0	33·0
	Oxford	31·4	+ **6·5**	72·5	70·0	37·0	27·0
	Darfield	26·1	− 2·1	71·2	71·3	26·0	21·0
	Hororata	38·2	+ **3·7**	71·5	71·3	32·0	22·0
	Prebbleton ..	27·2	− **2·7**	72·9	70·5	25·0	20·0
	Lincoln	43·4	− 2·0	71·4	70·3	26·0	17·0
	Irwell	25·8	− 1·1	72·8	69·3	32·0	21·0
	Dorie	19·7	− **4·9**(7)	71·4	70·5	35·0	37·0
	Rakaia	32·7	0	71·6	69·6	31·0	28·0
	Wakanui	32·9	− **1·4**	71·3	68·4	34·0	18·0
	Methven	42·3	+ **4·8**	71·6	68·0	34·0	26·0
	Hilton	25·5	− 2·0	71·8	71·4	32·0	24·0
	St. Andrews ..	35·6	+ **1·3**	71·6	66·6	26·0	27·0
	Hadlow	52·6	− 1·6	71·7	71·6	30·0	25·0
	Morven	52·0	− **5·7**	71·8	68·5	28·0	34·0
	Pukeuri (A) ..	26·8	− 2·8	72·0	69·2	22·0	21·0
	Pukeuri (B) ..	25·1	− **2·9**	71·8	68·6	28·0	28·0
	Ngapara	62·1	+ **6·6**	71·2	68·9	30·0	28·0

(1) Rod-row trial; yield in grammes per plot. (2) Not 7·03, but the closely related line 7·02, which in other localities yielded equal with 7·03. (3) All replications of each variety threshed together, no statistical treatment possible; Tuamarina result doubtless significant. The large difference in favour of Cross 7 is probably due to Tuscan being damaged by frost. (4) Difference barely significant. (5) Stooks of both varieties damaged by stock, result therefore not fully significant. (6) Both varieties slightly frosted, Cross 7 more than Tuscan. (7) This result is not fully significant, owing to a mistake in sowing which resulted in a rate of seeding of 180 lb. per acre, against the intended rate of 120 lb., and the customary rate in the locality of 80 lb. Obviously the exceedingly high seeding on the light type of soil created conditions widely different from normal.

It follows that there is a more general tendency for lower yields in Cross 7, although the number of significant-yield differences is almost equal in both cases (six versus eight). The resulting average loss for Cross 7 is less than 1 bushel per acre, which, in view of the limited number of experiments, must be considered negligible. By making an appropriate use of the results of these and further experiments and of growers' observations, it should be possible to define those areas in which the prospects for equal, or higher, yields of Cross 7 are best. Even in the least suitable locality no farmer who choses to grow Cross 7 runs a risk of any considerable loss.

Grain Quality of Cross 7.

(1) *Flour Extraction.*

Flour-yields were obtained on the experimental flour-mill of the Wheat Research Institute, Christchurch. With reference to the significance of these data, Mr. H. E. West, Research Chemist, Wheat Research Institute, states:—

"Milling-yields are comparative within themselves, if the samples are of the same moisture, the same texture, and the same maturity. They have little real practical significance, as commercial yields are varied to suit moisture, output per hour, mill design, and quality of flour desired. On normal wheat, both experimental and commercial milling trials do not signify the actual flour-yields, but only the relative ease of obtaining a certain extraction."

It can be concluded that the pairs of results are comparable within themselves, although the practical significance of their differences should not be overestimated.

Of thirty-five pairs of results from comparative trials during four seasons (see table), thirty-three show higher flour-yields for Cross 7, and only two for Tuscan, the values of the latter being negligible (0·1 and 0·5 per cent. over Cross 7).

If all thirty-five trials are combined, the following mean values are obtained: Cross 7, 72·3 per cent. flour extraction; Tuscan, 70·1 per cent. flour extraction. Difference, in favour of Cross 7 = 2·2 per cent. additional flour extraction.

(2) *Baking-value.*

The baking trials followed the procedure described in the First Annual Report of the Wheat Research Institute, p. 15. Differences of about five points and over are truly significant. Out of thirty-five comparative results, only three are distinctly in favour of Tuscan (see table). One of these exceptions, Lincoln, 1931–32, is due to the remarkably high baking score for Tuscan, exceptional not only in relation to other Tuscan samples, but also in comparison with the baking scores of numerous other, commonly superior, varieties grown simultaneously on the same field. In addition to this case, there are only two significantly lower baking scores for Cross 7, viz., Springbank and Morven, 1933–34. It is noticeable that in both cases the yields of Cross 7 were significantly lower.

If all thirty-five pairs of results are combined, the following mean values are obtained: Cross 7, 30·7 points; Tuscan, 25·2 points. Difference in favour of Cross 7, + 5·5 points.

There can be very little doubt that in the majority of cases Cross 7 has given a markedly superior flour.

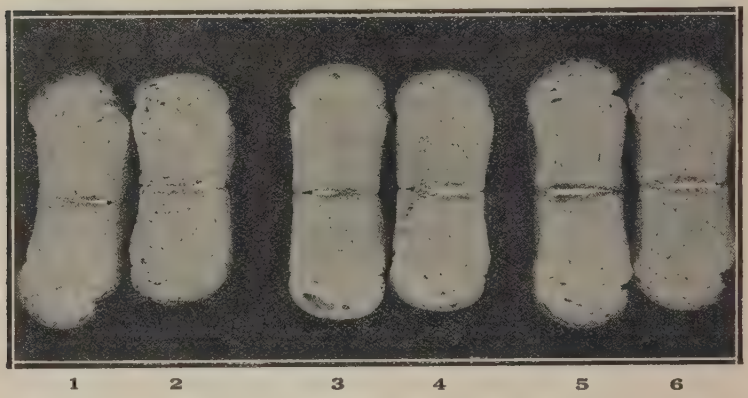

FIG. 2.

Three pairs of loaves of Cross 7 (1, 3, 5) and Tuscan (2, 4, 6) from variety trials, 1933–34, both varieties grown under identical conditions. In the pairs 1–2 (Oxford) and 5–6 (Rangiora) the differences in baking scores are large—viz., 10 and 15 points respectively in favour of Cross 7—whereas in 3–4 (Darfield) the difference is only 5 points, corresponding to the average advantage of Cross 7 over Tuscan. In all three pairs the higher quality of the Cross 7 loaf is apparent, particularly in volume, texture, and crumb colour.

Acknowledgments.

The work reported in this paper has been made possible by the co-operation of plant-breeder, cereal chemist, and field experimentalist. It has essentially been team work throughout the testing period.

The author is specially indebted to Professor F. W. Hilgendorf, Director of the Wheat Research Institute, who made the cross, and, together with Mr. J. W. Calder, conducted the breeding to the fifth generation—he supplied the F 5 material from which Cross 7 was selected, and has also given continuous encouragement during the breeding process; and to Mr. H. E. West, Research Chemist, Wheat Research Institute, who supplied all data on milling and baking characteristics and bushel weights recorded in this paper. Valuable criticism and assistance has been obtained from the members of the "Specialists" Committee of the Institute, consisting of the above-named members of the Institute and the following officers of the Department of Agriculture: Messrs. J. W. Hadfield, A. W. Hudson, and J. C. Neill. Further acknowledgment is due to Professor R. E. Alexander, Director, and Mr. R. A. Fougere, Farm-manager, Canterbury Agricultural College, for continued assistance and co-operation at Lincoln.

The author has been in the particularly happy position of being able to rely upon the co-operation of the Fields Division of the Department of Agriculture for field tests throughout the wheat-growing area. To Mr. A. W. Hudson, Crop Experimentalist, Plant Research Station, and to the staff of the Fields Division in Canterbury and Otago, specially Mr. R. McGillivray, Fields Superintendent, and Messrs. W. Stafford (Timaru), E. M. Bates (Ashburton), G. Calder, and H. de O. Chamberlain (Christchurch) and Elliott (Blenheim) in the Canterbury district, Mr. R. B. Tennent, formerly Fields Superintendent, and Mr. T. Sellwood (Oamaru) in the Otago district, the credit is due for organizing and conducting a dense network of variety trials of high reliability, which both in extensiveness and accuracy of results have hardly been excelled in any part of the world.

Mr. J. W. Hadfield, Agronomist, and Mr. R. Thomson, Assistant in Agronomy, have been responsible for the production of pure seed for distribution.

Special thanks are due to the numerous farmers who co-operated in conducting field trials, and to Mr. C. H. Hewlett, General Manager, Canterbury Seed Co., Ltd., for the hot-water treatment of the seed and for organizing its propagation.

Summary.

(1) The parents of Cross 7 are Tuscan, a high-yielding New Zealand variety, and White Fife, a high-quality Canadian variety.

(2) The Cross has all the growth characters of Tuscan, including its resistance to the threshing action of wind. It is, moreover, about 4 in. shorter in the straw, four days earlier in ripening, markedly more resistant to lodging, and somewhat more resistant to straw-break. It is, however, probably more susceptible to loose smut.

(3) The yield of the Cross is, as the result of thirty-six trials in thirty-two localities from Blenheim to Oamaru, about three-quarters of a bushel less than that of Tuscan, and there are probably certain localities where its yield would be better than this.

(4) The percentage of flour produced is constantly 2 per cent. better in the Cross than in Tuscan.

(5) The baking-score of the Cross is almost constantly better than that of Tuscan, the average result being: Tuscan, 25·2 points; Cross 7, 30·7 points.

(6) About 3,000 bushels of seed are being distributed in 1935 in such a way as to secure the largest possible supply of pure seed for 1936.

In some circles there has perhaps been a tendency, because agriculture has been suffering from over-production to say that research should be curtailed. The present confused state of production, to my mind, constitutes a particularly strong reason why research should be expanded. In this crisis, in which we are attempting to blaze new ways out, it is folly to operate under a dim light. In the first place, the problem of the individual farmer is never as before keyed around economy of production and quality of product. If we are to regain our foreign markets and expand our domestic demand the type of research having to do with production costs and quality of product is needed as never before.—*Henry A. Wallace.*

SULPHURIC-ACID TREATMENT OF MANGEL SEED.

AN ACCOUNT OF WORK RELATIVE TO THE YIELDS OF TREATED AND OF UNTREATED SEED.

H. P. DONALD, Canterbury Agricultural College, Lincoln.

IN 1927 experiments were undertaken at Cambridge University to test the possibility of improving the germination of sugar-beet seed by treatment with strong sulphuric acid. The yield of sugar beet is closely associated with the completeness and evenness of the strike, so that the slow and uncertain germination of the seed has probably a deleterious effect on the size of the crop. The results of laboratory and field tests of treated seed against untreated which have been published by Hanley and Woodman and Garner and Sanders show quite clearly that over a period of three seasons treated seed of sugar beet germinated more quickly, gave a fuller "plant," and resulted in a greater yield of roots than untreated seed.

The close resemblance of mangel and sugar-beet seed caused Mr. H. J. Geddes, formerly of Canterbury Agricultural College, Lincoln, to try the treatment with mangel seed, which, particularly in areas liable to dry spring seasons, germinates very irregularly. Laboratory germination tests indicated that, like sugar beet, mangel seed germinated much more quickly after acid treatment. Garner and Sanders have also been working with mangels, but so far have not found an increased yield (although the plant population was greater) after the sowing of treated seed.

In the spring of 1933 further investigation of the effect of treatment on germination and yield was undertaken at Lincoln, and the results which follow were obtained.

The two main advantages of faster germination would be:—(1) Establishment of seedlings in soils too dry to suit ordinary seed; and (2) more successful competition with weeds. Good cultivation does much to secure reserves of moisture in the soil and reduce the amount of weed-growth, but improved germination undoubtedly is of considerable complementary value. Counts of plants have, therefore, been made in the field at short intervals after seedlings began to appear, and an attempt was made to estimate the effect of number of plants per chain on final yield.

METHOD OF TREATMENT.

The mangel "seed" or cluster consists of as many as five or more true seeds encased in the hard corky remains of the mangel flowers. The outer casings appear to retard the penetration of moisture to the seed, so that methods of removing part of them permit faster germination. Mechanical milling has been tried with some measure of success (Garner and Sanders). Strong sulphuric acid acts rather differently. Much of the corky part of the cluster is actually burnt off, and the "seed" becomes darkened, smoother,

and smaller. In this condition it seems to wet more easily, and possibly forms a closer contact with the soil. The small caps which fit over the seed are also more readily dislodged.

With some modifications, the method used by Hanley and Woodman was followed.

The seed was placed in a large earthenware receptacle, and enough strong sulphuric acid (80 per cent.) added to wet it thoroughly. The seed was stirred periodically to mix it well with the acid, and at the end of forty-five minutes plunged into a large bucket with water running rapidly through a gauze panel in the side. After washing for fifteen minutes in this way, the seed was transferred to another bucket of water made just alkaline with ammonia. This was repeated until the washings became neutral to litmus, usually after three changes of water. After another two minutes' rinsing in fresh water the seed was drained, spread thinly on paper, and placed in a drying-room. Great care should be exercised in handling sulphuric acid, which may inflict very severe burns, and even blindness if it splashes into the eyes. Acid-resistant vessels such as earthenware basins should be used, and a good supply of water kept handy. Should acid be spilled on the skin, it is advisable to wash well with plenty of water and then bathe with dilute ammonia or lime water. Neutralizing the acid first with alkali is to be avoided.

Some of the seed was treated with 98 per cent. commercial acid in these investigations. It was found that 1,000 c.c. of this acid added to 365 c.c. of water gave the desired concentration of 80 per cent. One pound of seed requires from 250 to 300 c.c. of acid, and during treatment decreases about 20 per cent. in weight if little or no seed is lost.

Laboratory Germination Tests.

Detailed investigation of the effect of the acid on germination has not taken place. Certain tests made, however, bear out the more extensive results for sugar beet already published. The temperature of the incubator unfortunately varied up to 3 degrees C. on either side of 25 degrees C., but so many trials were made in various parts of the incubator that it is certain that the germination was hastened. Some typical results with different lots are—

Table 1.

	Number of Seeds per 100 Clusters germinated on Fifth Day.
Untreated	30
Treated	113
Untreated	3
Treated	110
Untreated	37
Treated	64
Untreated	3
Treated	70

Field Germination.

On 4th October, 1933, treated and untreated seed was sown on a ridged field at Lincoln. The land was in potatoes the previous year, and was well cultivated. Fertilizer at the rate of 3½ cwt. of mixture of superphosphate, sulphate of ammonia, and potash in the proportions 4 : 3 : 2 was broadcast before ridging, and a further 1 cwt. of superphosphate was applied with the seed. The experimental area was sown with a P. and D. Duncan mangel-sower, distributing the Long Red variety as follows: Untreated, two rows; 98 per cent. sulphuric acid, two rows; untreated, two rows; 80 per cent. sulphuric acid, two rows. This was repeated and then another two rows of Long Red untreated sown. A similar and adjacent layout was adopted for the Yellow Globe variety. The ridges were firm and fairly moist inside, but were rather dry when rain fell sixteen days later. One week after sowing seedlings of fat-hen and a few mangels appeared. Germination was still backward on 23rd October. The rain which fell just previously rendered germination more difficult by caking the ridges. Some damage, particularly to the Yellow Globes, was done by birds. The crop was hoed and singled in late November, and received several horse-hoeings after this.

On a neighbouring portion of the same field 3 acres of mangels were sown on the flat. Practically the same quantities of fertilizer were applied. The soil was in good condition and quite moist just below the surface. From observation on this area, it appeared that the mangels germinated more quickly on the flat than on the ridges, and that treated seed germinated distinctly better than untreated.

Rate of Seeding.

It was found impracticable to sow equal numbers of treated and untreated seed with the machine used. The rate of seeding would clearly have a considerable influence on the apparent speed of germination, so that the following figures are important in evaluating the results of the germination counts. They show, unfortunately, that the rate of seeding was probably very different from row to row.

Table 2.—Estimated Number of Seeds sown per Chain.

Ridges.		Flat.	
Long Red (98 per cent. acid)	450	Long Red (98 per cent. acid)	580
Long Red (80 per cent. acid)	290	Long Red (control)	680
Long Red (control)	570		
Yellow Globe (98 per cent. acid)	350		
Yellow Globe (80 per cent. acid)	250		
Yellow Globe (control)	430		

These figures draw attention to the huge excess of seeds sown. If 6 lb. of seed are sown to the acre, about 180,000 clusters are sown on 280 chains of row. This is equivalent to about 640 clusters per chain or 10 per foot. If the mangels are thinned to 1 ft. apart, ten times too many clusters and thirty times too many

seeds are sown. Mangel clusters usually have about 95 per cent. laboratory germination. The great excess of seed which it is found necessary to sow must be due either to faulty drills or to unsuitable soil conditions.

Comparison of Germinations and Yield in the Field of Different Treatments and Varieties.

Germination counts were made on four columns 1 chain wide marked off across the ridges, and spaced so as to be representative of the whole length of the ridges. Four replicates of each treatment for both varieties, together with four corresponding control (untreated) replicates, occurred in each column, so that altogether each figure on which conclusions were based was the average of sixteen paired plots each 1 chain long.

Field germinations were counted on three dates before thinning, and on a final one when the roots were weighed at harvest.

The results were entirely inconclusive. Of the twelve comparisons (two varieties, two acid strengths, three dates) made before thinning, the differences from control were non-significant in nine cases and significant in three. After thinning eight comparisons (two varieties, two acid strengths, two dates) gave non-significant differences in five cases and significant in three. The weights of roots harvested showed a significant difference when Long Red treated with 98 per cent. acid was compared with control, but non-significant differences in the three other cases.

Conclusion.

Work at the Cambridge University indicating improved germination of acid-treated mangel seed has been supported by investigations at Lincoln. There is, however, as yet, insufficient evidence to conclude that yields are increased by the treatment. It should be borne in mind that, since so many seeds in excess of requirements are sown, it will be only in seasons or areas of very poor germination of untreated seed that treated seed may show any final superiority of yield. Work at Lincoln seems to emphasize again the importance of good cultivation during the preparation of a seed-bed, and of proper thinning. The best thinning distance naturally varies, but on the plots examined this year the best yields were obtained with at least sixty plants per chain.

Notes.

The investigation is reported in detail in the half-yearly report of the research work done at Canterbury Agricultural College. The report includes tables showing laboratory field germinations at different dates, germinations of seeds of different sizes, the effect of thinning to different spacings, the weights of individual roots, as well as the result of a uniformity trial. A copy of the detailed report will be sent to scientific workers asking for it.

The author wishes to acknowledge the assistance he received from Mr. R. A. Fougere, Farm Manager, for willing co-operation in the field work, and from Messrs. Blair, Elliot, and Fleming, degree students, who carried out much of the harvesting and statistical work.

Mr. C. E. Iverson, M.Agr.Sc., of Napier Boys' High School, last year made a trial of the sulphuric-acid method of seed treatment on land similar to that exposed by the drainage of the Ahuriri Lagoon. He used the Yellow Globe and Long Red varieties in duplicated plots. In the Yellow Globe both treated and untreated germinated well, but in the Long Red the untreated plot germinated poorly. At harvest of the crop three weighings were made on each plot with the following results :—

Variety.	Treated Seed.	Untreated Seed.	Difference in Favour of Treatment.
	Tons per Acre.	Tons per Acre.	Tons per Acre.
Long Red	100·7	76·3	24·3
Yellow Globe	93·9	86·8	7·1

Mr. Iverson states that the increased yield of Long Red was significant, and that the high yield is indicative of what may be expected from development of the lagoon land.

HEALTH OF FARM ANIMALS.*

W. C. Barry, M.R.C.V.S., Director of the Live-stock Division, Wellington.

The subject of the health and maintenance of live-stock is of supreme importance economically. Its significance increases in proportion to the relative position occupied by agriculture and the live-stock industry in any particular country. Accordingly, in New Zealand, in which agriculture and the primary products are the mainstay of the population, the health of live-stock is a subject which vitally affects our economic interests. Health of live-stock is a question to-day of no less than international importance, as it is one intimately associated with the exportation of animal-produce from one country to another. Importing countries are each year becoming more exacting in their requirements regarding certification of freedom from disease in all meat and other animal-products allowed entry. It is questionable, however, whether the significance of this is really appreciated, and whether a full realization of the responsibility that rests on those who are entrusted with the protection of the health of live-stock exists in this country. The fact that not one carcass of mutton, beef, or pork can be exported without veterinary certification is a forcible illustration of the point raised.

The relationship of animal-health to the export of our primary products, is, however, only one aspect affecting the stockowner. Loss, wastage, and deterioration brought about by disease in stock is another, and probably the one which appeals most in that the economic loss involved is at once apparent.

The maintenance of animal-health involves the procedure associated with the practice of preventive veterinary medicine, and includes, firstly, protective quarantine measures such as are to-day recognized as affording adequate protection against the introduction of disease, and, secondly,

* Substance of an address broadcast from Station 2YA on 14th May, 1935.

deals with the cure and prevention of such diseases as are existent in the country. Prevention can again be split up into the use of animal-inoculation in certain diseases, the adoption of the principles of veterinary hygiene in the control of disease, and, lastly, and probably the most important of all, improved practice of animal-husbandry, which means a fuller recognition and application of the better care, feeding, and general management of all classes of live-stock.

Quarantine measures in the protection of animal-health become increasingly necessary as the present-day speeding-up of overseas communication progresses even the possibility of aerial transport as a means of introducing disease cannot be ignored. The introduction of rabies in a dog surreptitiously brought into England by aeroplane from the Continent some years back is a case in point. The introduction of the virus of one or other of the animal plagues which are endemic in Asiatic countries by means of aerial transport is not beyond the realms of possibility in the future. To the ordinary individual the subject of quarantine begins and ends with the total prohibition of animals from a particular country, or their admittance subject to a period of detention in isolation on arrival. Actually, in many instances this is not the most important aspect of quarantine work, and of far greater significance is the possibility of the introduction of serious animal disease without the importation of the live animal. To understand this danger it is necessary to explain that the specific virus which causes certain diseases can be present in the animal body during the incubative period of the disease -in other words, before any symptoms of the disease manifest themselves. If such an animal were killed at this stage, the carcass would contain the virus, which is capable in many instances of living for considerable periods, and may be carried to distant countries on board ship. Meat-scrap, bones, &c., from such carcass, if put ashore as ship's garbage, may, if fed to animals, start an outbreak. Foot-and-mouth disease and swine-fever are two diseases which have been introduced into countries in this manner. An outbreak of foot-and-mouth disease which occurred in California a few years ago was traced to the feeding to pigs of garbage from a steamer which was in port at San Francisco and which had provisioned meat at one of the South American ports, in a country in which foot-and-mouth disease was present. Rinderpest, or cattle plague, which is endemic in Southern Asia, and which has caused enormous losses in Egypt and South Africa, is caused by a virus which can retain its virulence for months, and so the arrival of infected material on ships from the East is accordingly possible. Only a few years ago an outbreak of rinderpest, which fortunately was quickly suppressed, occurred in Western Australia. In this instance the infection was brought in live animals used as ship's stores on board a steamer from Asiatic ports. Anthrax can be introduced in infected bone manure, hair, skins, &c. Outbreaks of anthrax in New Zealand in former years were traced to imported bone manures, and were controlled by a regulatory system of manure-sterilization. Bone manure was also a medium of the introduction of the disease known as blackleg.

What has been said indicates the importance of rational veterinary quarantine regulations, and the constant vigilance which must be exercised in port quarantine inspection work, if animal disease at present exotic to New Zealand is to be kept out of the country. Referring to

this, Sir Arnold Theiler, the eminent South African veterinary scientist, during his visit to New Zealand last year, expressed the opinion that our greatest danger zone in this respect was formed by Asiatic countries, through the possibility of disease reaching New Zealand in some way or other by ships from Asiatic ports.

The oft-repeated maxim that prevention is better than cure can be claimed to reach its highest significance in its application to animal-disease. The cure of a sick animal is, no doubt, a most desirable object, but in the prevention of disease lies the desideratum to be aimed at both by veterinarian and stockowner. A large percentage of the diseases affecting live-stock in this country can be prevented to a considerable extent if certain prescribed essentials are carefully followed out. Unfortunately, the road leading to prevention is not always an easy one to follow, involving, as it frequently does, laborious precautions and the adoption of troublesome detail. Nevertheless, the stockowner who has sufficient interest in the matter, and is prepared to go to a certain amount of trouble, can, as a recompense for his efforts, achieve highly profitable results in the direction of disease-prevention amongst his live-stock. Numerous instances of this can be recorded: two of them follow. The disease of dairy cows known as mammitis is responsible for heavy loss to the dairy industry. Admittedly there is no curative treatment which as yet can be relied upon. Preventive inoculation likewise is disappointing. Nevertheless, if certain control measures be adopted, the spread of the disease through a herd can be prevented. These measures involve a monthly bacteriological examination of the milk of each cow in the herd—this is done for the farmer, free of charge, by the Department of Agriculture. Grouping of the cows into (*a*) healthy, and (*b*) those capable of spreading the infection, with separate milking of the groups, coupled with rigid application of prescribed hygienic precautions in the milking-shed, has been productive of very gratifying results. This control has received its widest adoption in the Waikato district, where a number of dairy-farmers have achieved such good results over several seasons that they are prepared to go on with the method. A second example of the reward of preventive measures can be instanced in the disease of sheep in Hawke's Bay known as "black disease." A few years back this was responsible for rather heavy losses on farms in certain areas of Hawke's Bay. The disease, a bacterial one, was earlier shown in Australia to be associated with the presence of the parasite known as the liver fluke, which is found in sheep in Hawke's Bay. If the liver fluke could be prevented, "black disease" disappeared. The elimination of the fluke involved drainage of swampy areas, the dressing of such areas with copper sulphate solution, and the medicinal dosing of sheep with the drug carbon tetrachloride. The advice given by the Department of Agriculture was adopted by a large number of sheep-farmers in the affected areas, with the result that "black disease" has practically disappeared from those farms, and has ceased to be the cause of the serious losses previously encountered.

Preventive inoculation is practised and affords protection against many of the more serious animal-diseases. In countries in which they exist, such diseases as rinderpest, anthrax, pleuro-pneumonia, and swine-fever are to a large extent limited by the application of preventive vaccination. Unfortunately, vaccination has not yielded results in some of the more common stock diseases. Vaccination against blackleg has

been carried out for years past by the Department in those districts of the North Island in which this fatal disease of calves is prevalent, preventive inoculation in this instance being eminently successful. The possibility of vaccination as a means of disease-prevention is a natural desire on the part of stockowners, in the hope that the insertion of a dose under the animal's skin by means of a syringe will end trouble and obviate more laborious preventive measures. The wish is perhaps excusable, but we are, as yet, far away from the millennium in this respect.

In the adoption of improved methods of animal husbandry lies our greatest chance of lessening the incidence of animal-disease and of raising the standard of animal-health. Animal husbandry collectively includes the general management and feeding of live-stock and the application of approved hygienic measures, where such are needed. The role which management and feeding play in the maintenance of animal-health cannot be emphasized too forcibly. Generally, the management of stock in this country very frequently follows an established rule-of-thumb system which does not encourage the individual study of stock requirements, and therefore falls short in producing the best results. It is questionable whether the average stockowner appreciates his full responsibility in this respect. In delegating the work to others he often neglects that supervisory attention which is essential if any degree of interest in the performance of work is to be expected from those who execute it. Yet the owner is the person primarily responsible, and it is apparent that if he entrusts to others -either in the capacity of share milker, or ordinary employee—the duty of looking after his animals he is failing in his responsibility if such animals are in any way neglected. This lack of detail is not intentional, rather is it the outcome of a trend of indifference which is very apparent to any one who is brought into intimate contact with the matter. The reason for this has often been asked, and generally it is accepted that the matter had its origin in the low values of stock in this country originally, conducing to the view that it was not worth while paying attention to the subject. This explanation cannot be accepted to-day, when the increasing and national importance of milk- and meat-producing animals demands an enlightened view, not only of the diseases to which such animals are liable, but of all the conditions that have any bearing on the daily routine of their existence. One of the surest means of inculcating regard and interest in the welfare of animals under their charge is the education of the youth of the country in this direction, and towards this end the movement known as Boys' and Girls' Calf Clubs, and similar organizations, are assuredly on right lines. The stimulus here given to boys and girls to take an interest in their animals, introducing as it does the competitive element, is of tremendous value in cultivating that watchful care and keen sense of observation of the animal's progress which lays the foundation of the requirements of a successful stockowner. The latter is, as a rule, one who can pick out at a glance the animal which is not thriving as well as it should, and can apply his knowledge to seek the cause. In no walk of life is a keen sense of observation more necessary than to the person who has charge of live-stock. This is a faculty not possessed by all alike, and is probably to a certain extent inborn, but can, however, be very largely cultivated. Another important educative function of the Calf Clubs' activities is

the training of boys and girls in the proper manner in which to handle stock, and this is a point of the greatest importance. Nothing is so obnoxious to the real lover of animals as to see them treated in that careless and rough manner which at once stamps the person so guilty as better suited to some other occupation.

In successful stock management the provision of a plentiful food-supply during those periods of the year when seasonal influence limits the growth of ordinary pasture is a highly important factor. From the animal-health point of view, the provision of adequate winter feed for dairy cows is of enormous significance. This particular subject has been repeatedly stressed, but its importance fully justifies reiteration. From the drying-off period to her next calving is a period of the cow's existence when Nature demands a repletion of the drain on her system, mineral and otherwise. We must endeavour to effect this by supplementary feed. Well-saved hay, good silage, adequate supply of roots, concentrates, if necessary, the use of bone-meal licks, &c., are all indicated in the successful wintering of the dairy herd. There is very little doubt that many of the troubles which affect dairy cows after calving could be minimized materially by better attention to winter feeding, coupled with better provision of shelter during the winter months. In sheep husbandry, also, the maintenance of the in-lamb ewe's condition at a satisfactory level during the winter months is known to influence largely a diminished incidence of those troubles associated with the lambing period. In this direction, the winter feeding of silage to sheep is a subject worthy the attention of sheep-farmers.

Many of the troubles which occasionally affect stock in New Zealand are seasonal in their occurrence, and are usually precipitated by abnormal pasture conditions. Although it is perhaps at times possible to anticipate such as the result of abnormal climatic conditions affecting pasture, their prevention is a difficult matter, and a lessening of the incidence of such troubles, when they do occur, is a problem which taxes the farmer's skill in stock husbandry to the utmost. An instance can be quoted in the condition known as "facial eczema" or facial dermatitis in sheep. This peculiar affection, which commences with an œdematous or swollen condition of the skin of the sheep's head, accompanied by irritation, very frequently ends in such severe scab-formation on the face and nostrils as even to cause blindness and extreme difficulty in breathing. The actual skin condition is known to be the result of what is termed photosensitization, or excessive sensitivity to the sun's rays. The sensitization is produced as the result of some systemic disturbance, dietetic in origin, and associated with rapid growth of feed of a luscious nature, such as occurs in the autumn period when the rainfall is above the average, and always following a preceding dry summer. Research in South Africa has recently shown the sensitizing agent to be a substance named Phylloerythrin, derived from the chlorophyll or green colouring-matter of plants. Facial dermatitis was extremely prevalent in many districts of the North Island during the autumn of the present year, when the conditions of pasture referred to were strongly in evidence. In this disease the primary disturbance appears to be connected with the function of the liver. Departmental inquiry into this trouble has been very extensive during the past autumn period. Amongst control

measures suggested, obviously the most important one is to change the sheep on to short feed. This might mean previously eating down a paddock by means of cattle, and then crowding the sheep thereon. It undoubtedly presents a difficult problem to the sheepowner, and is referred to here as one of the sheep troubles in which dietetic factors play such a prominent part. Another example is the disease of sheep known as ante-partum paralysis, or sleepy sickness, which affects ewes shortly before lambing. Here, however, in contradistinction to facial dermatitis, green feed does good, and the sheep-farmer who has made provision for some green feed, in the shape of green oats, barley, or young grass, will find a change on to such of distinct advantage when sleepy sickness is prevalent amongst his ewes before lambing.

FARMING IN THE AUCKLAND PROVINCE.

OBSERVATIONS ON FARM-MANAGEMENT METHODS.

P. W. SMALLFIELD, Fields Superintendent, Auckland.

FARMERS seldom write about farming: this is left to journalists and professional instructors in agriculture, who sometimes describe farming as the writers think it ought to be, rather than what it is. The real study of farming is the study of individual farms, and it may be of interest to turn and look at farms as they really are: to look at the land and pastures, crops and live-stock, and observe local methods of farm management.

The Auckland Province contains good soils and poor soils, heavy soils and light soils, swamps and plains, hills and mountains, all of which are farmed, here and there, in one way or another. I propose to take you over the province, north and south, east and west, to look at dairy-farms and sheep-farms, finished farms and partially developed farms; to see unimproved scrub-covered hills and bush-clad mountains: to see and hear all we can travelling right through the province from the sandy peninsula of the far North to the pumice plains of the central plateau.

I. NORTH AUCKLAND.

The long, narrow North Auckland Peninsula extends in a north-westerly direction from Auckland City: it is two hundred miles long and its greatest breadth is sixty miles. The land surface consists of scattered fragments of mountain-ranges composed mainly of grey-wacke and basic volcanic rocks, joined together by hills and rolling downs of claystone, sandstone, and limestone. Here and there, as plateaux on the downs country, occur basaltic lava flows on which are scattered low, steep-sided scoria cones; whilst in the far North and on the west coast are large areas of consolidated sand.

Originally most of the country was heavily forested. The mountain-ranges, the basaltic lava plateaux, and much of the sandstone and limestone formations were covered in mixed bush, with the kauri, puriri, and totara as common trees. Open scrub country occurs throughout the North, areas of which once carried heavy forests, but where prolonged soil leaching has lowered the soil fertility to a point

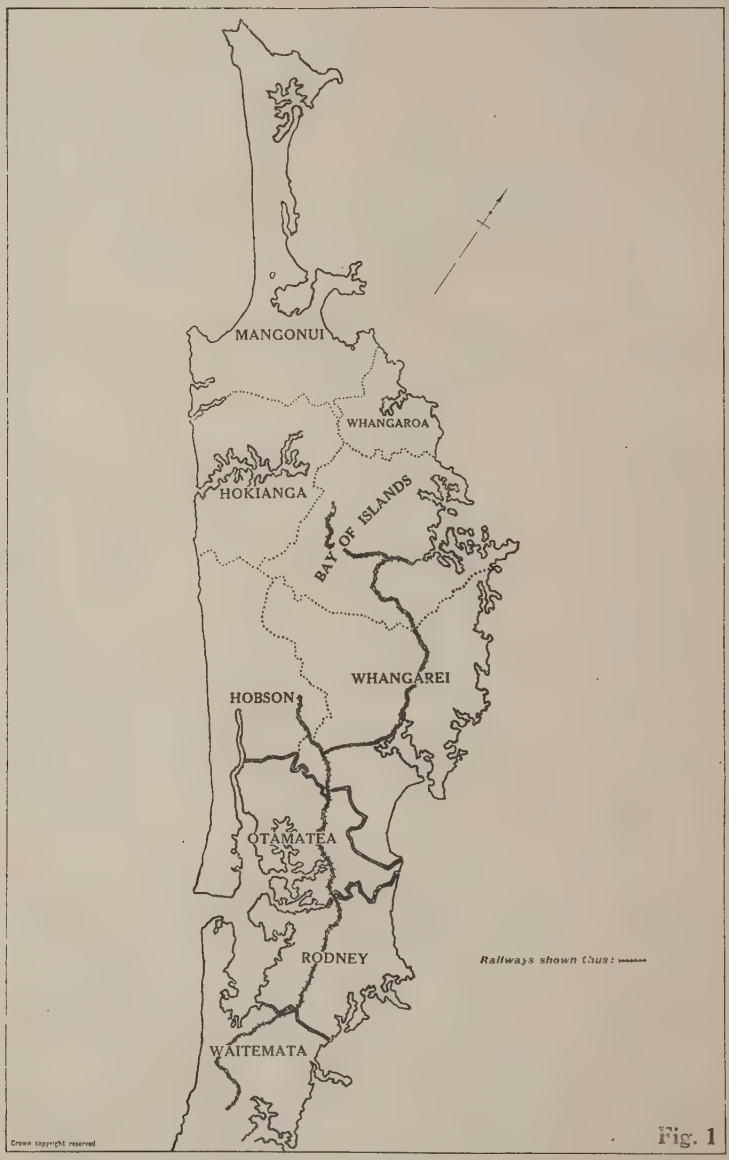

FIG. 1. COUNTIES OF NORTH AUCKLAND.

where manuka and fern have taken the place of the original forests—*e.g.*, the "gum-land" soils, mature podsols, found on Onerahi claystones and limestones of late Cretaceous age and on Waitemata and Whangarei sandstones and claystones of Miocene age(1). There are also areas of laterite and lateritic soils(2), soils derived from basalt and which have been subject to leaching, and iron podsols on the coastal areas of consolidated sand. The forested country was first settled, whilst the open scrub country, of low natural fertility, is still largely unoccupied.

The climate of North Auckland is warm and temperate: the prevailing winds are westerly. The mean annual rainfall varies between 40 in. and 70 in. in different localities: some of the elevated areas on the west coast have a rainfall of over 100 in. per annum.

*Crops and Live-stock.—Table showing Areas in Crops and Pasture and Numbers of Live-stock in North Auckland Counties, 1933–34.**

County.	Crops.			Live-stock.			
	Annual Crops.	Pasture.	Pasture cut for Hay and Ensilage.	Dairy Cows.	Other Cattle.	Sheep shorn.	Pigs.
	Acres.	Acres.	Acres.				
Mangonui ..	416	109,531	1,456	22,046	21,782	60,822	5,686
Whangaroa ..	160	27,216	369	4,313	4,342	17,948	1,287
Bay of Islands ..	1,936	155,149	2,850	23,402	30,271	91,881	6,456
Hokianga ..	509	141,896	873	18,850	27,504	95,916	4,992
Whangarei ..	2,108	298,468	7,931	57,792	54,887	134,804	14,429
Hobson ..	1,154	189,721	3,594	34,353	36,564	105,789	9,712
Otamatea ..	968	158,295	3,422	30,392	29,786	88,442	9,877
Rodney ..	1,547	159,198	3,998	26,240	25,342	95,265	7,260
Waitemata ..	2,013	124,943	6,941	32,244	22,128	73,006	10,730
Total ..	10,811	1,364,417	31,434	249,632	252,606	763,873	70,429

* From A. and P. Statistics. Note.—North Auckland Land District includes Eden, Great Barrier, Manukau, and Franklin Counties, which are not shown in the above table.

There are two and a half million acres in occupation in North Auckland, of which some one and a third million acres are in permanent grass. One interesting feature of North Auckland farming is the importance of paspalum pastures. Sown originally on land that was subject to winter flooding, the grass now is being utilized generally in pasture mixtures on both ploughed and surface-sown land. It occupies somewhat the position in pastures that cocksfoot does farther south, but it has a much wider range of usefulness than cocksfoot: it will grow on wet undrained swamps, and loose sands and peats; for vigorous growth it demands soils of high fertility, but on poor soils, where cocksfoot would rapidly become tufted and stunted, paspalum will persist indefinitely with a close tight sward, although the production of feed is not large.

The area devoted to annual crops in North Auckland is small, about 11,000 acres, and practically the whole of this area is grass-supplementary crops—soft turnips, swedes, and rape. Where paspalum is the dominant pasture grass little supplementary cropping is done—viz., Mangonui and Hokianga Counties—but where paspalum is not so

dominant, particularly on the basic volcanic soil areas of Bay of Islands and Whangarei Counties, areas of roots and green crops are still grown for the summer supplementary feeding of dairy cows.

Dairying, pastoral farming, and fruitgrowing are the chief farming industries. There are a quarter of a million cows milked on dairy-farms situated chiefly on basic volcanic soils and flat alluvial land in the river valleys. Although there are numerous intensively managed dairy-farms, with a high production of butterfat per acre, the general dairy-farm management is extensive rather than intensive, and on many farms the production of butterfat per acre is very low: there is still the "bush" dairy-farm, where cow-bells are heard and stock are wintered in the bush. Pastoral farming consists in grazing Romney sheep and beef cattle, principally Shorthorns and Herefords, on the surface-sown hill country, and raising fat lambs on the basic volcanic land and easy rolling limestone country. The marketable products are wool, lamb, mutton, beef, and store stock. North Auckland is practically self-supporting in cattle and sheep; a small surplus of breeding-ewes is sometimes sent to southern districts, but generally lack the size and breeding of East Coast ewes; part of the supply of store cattle for fattening in Franklin and Northern Waikato Counties comes from North Auckland. Fruitgrowing is becoming quite an important industry: there are 4,000 acres in developed orchards, of which 2,600 acres are situated in Waitemata County.

WAITEMATA COUNTY.

June 11th, 1934: Glen Eden to Helensville.—Low undulating hills of gum-land clay surround the upper reaches of the Waitemata Harbour. To the north-west lie the Waitakere Ranges, of volcanic origin, and still partially forest-clad. These ranges, usually forming a striking feature of the landscape—looking dark and distant through the haze of a summer's day—are now hidden by misty rain which has been falling steadily since early morning. From Glen Eden to Kumeu are small farms—dairy-farms, orchards, and vineyards. Dark green lines of *Pinus radiata* trees mark the sites of orchards and gardens, which are interspersed with pasture land and grey and yellow areas in short manuka and gorse. Pasture land varies considerably, here closely eaten bright green top-dressed fields of rye-grass, paspalum, and white clover, there dry rank paspalum and tufty dry danthonia.

Just past Henderson I stopped to discuss with a farmer the treatment of an autumn-sown permanent pasture. The land had been cleared of stunted manuka and hakea last spring, ploughed and sown in grass in April. The trouble with the grass was the yellowing-off of large patches, and the farmer wanted to know what manure to use to put matters right. It was the farmer's first experience of grassing gum land, and he was far more interested in what manure ought to be used as a remedy than how to obtain better establishment in future sowings. The yellowing of the grass was due to lack of nitrogen and to overgrowth caused by late sowing, poor clover establishment, and inability to graze the rank rye-grass on account of the wet weather and soft, sticky ground. Success in grassing gum land is dependent on thorough and timely cultivation to give a moist and firm seed-bed for sowing in February

FIG. 2. JOURNEY IN WAITEMATA, RODNEY, AND OTAMATEA COUNTIES.

or early March, the use of perennial strains of rye-grass and white clover, and heavy applications of phosphatic fertilizers, and generally of lime. With early sowing on a moist and firm seed-bed clovers germinate readily and make considerable growth before cold weather occurs, and the first grazing can be made before the ground becomes soft and sticky.

The progress of development of the poor gum-land clays adjacent to Auckland during recent years has been really remarkable. Highly productive dairy-farms have been established on what was once considered an almost sterile soil. Hochstetter(3), who visited Auckland in 1858, has made some interesting notes regarding the early condition of the gum-land soils near Auckland. He writes :—

"The soil consists of a stiff whitish clay ('pipeclay'), being covered with dwarf manuka, fern, and a variety of small shrubs and tufts of grass. Nothing else seems to thrive on this sadly sterile soil, and yet that very soil bore in olden times luxuriant forest trees.

"This circumstance gives rise to various reflections : for the sterile pipeclay soil occupying such extensive tracts in the vicinity of Auckland, and especially in the districts east and west of Auckland, in which nothing will grow, not even grass, is a real calamity. The question arises : Is there no means to restore to the soil the productive power which it must necessarily have possessed of old when it produced these towering kauri forests, traces of which are plainly seen in the kauri-gum which the Natives are everywhere digging from the surface of that soil ? Experienced farmers must decide this question by direct experiments. At any rate, however, the method usually pursued by the colonists upon fern heaths seems to be throughout a perverse one. If, immediately after the burning-down of the woods, grass and clover seed had been sown in its ashes and humus, a heavy growth of grass might perhaps have preserved the humus of the surface soil. But they burn again and again ; the winds carry off the ashes ; the rain is gradually washing the humus away, and at last nothing remains but the naked clay soil upon which *Leptospermum* (manuka) and *Pteris* (bracken fern) are scantily thriving. And in consequence of the usual burning system, even these plants are not allowed to grow strong and hardy and gradually reproduce humus ; but year after year these bushes are set on fire and burnt down. The owners of the ground assert that this is done because cattle are fond of browsing the tender shoots that spring up after the conflagration. But these are growing more and more scarce from year to year, and a system, perhaps correctly applied to a fertile soil, for the purpose of exterminating the luxuriant growth of fern and preparing it for a crop of corn is certain to crush upon this stiff dry soil the last scanty trace of verdure. The method of burning out was originally a custom of the Natives, who by burning cleared the forest, tilling it once after burning, and then went again in search of new ground. Thus applied the system is a correct one, but repeated burning is an abuse. After the first burning luxuriant undergrowth is produced ; after the second both flax and fern, finally dwarf fern and manuka, and last of all naked soil remains."

The gum-land soils occur in patches right through North Auckland : the areas consist of undulating treeless downs rising occasionally into low hills. The surface soil consists of grey silts and clays, podsols—*i.e.*, acid soils of low fertility formed under conditions of intense leaching. The grey silts, from which most of the kauri-gum was dug, show the effects of mature podsolization. Drainage is bad, and rushes form the chief part of the natural covering along with manuka ; the clays are drier and are covered in bracken fern and manuka. The gum-land soils were long neglected for farming : large areas were set aside as kauri-gum reserves, and it was only when gum-supplies became exhausted and gum prices were falling that any attention was paid to the farming possibilities of these areas. Also, as long as more fertile land was available no one bothered about these sterile soils. Early experimenters apparently never anticipated that these areas could

be made to grow good rye-grass - paspalum - white-clover pastures after being once broken up. Early development experiments aimed at first raising the soil fertility by ploughing in green crops, the use of burnt lime, subsoiling, and tile drainage a very expensive programme. The next stage was the use of *Lotus hispidus* in pasture mixtures—a legume which thrives on a soil below the level of fertility required by white clover. Then came certified rye-grass and white clover, careful cultivation, the use of phosphates and ground limestone; and recent work has shown that these areas can be grassed at a cost of from £6 to £8 per acre.

Last autumn I saw some very successful grassing of gum land in Bay of Islands County. The virgin land was a poor grey silt, badly dug over, with large holes filled with stagnant water and timber. Taken in the rough it looked a tough proposition. In breaking in the land the settler first carried out some preliminary levelling and hole-filling. He then ploughed with a shortbreasted single-furrow plough, harrowed, and then ploughed again. The first ploughing was done in the autumn and winter and the second in the spring. The surface soil was harrowed and worked over the summer and made ready for sowing grass in February. Thorough and early cultivation with two ploughings gave an excellent seed-bed: the bottom was moist and firm—firm with natural consolidation. The surface was covered with small clods which would break down with the autumn rains and prevent the surface caking. When inspected last March grass-seed sown in February was coming up and the strike of grass and clover was excellent. Pastures twelve months old were good swards of perennial rye-grass and white clover. On this farm good cultivation, good seed, lime, and superphosphate spelled success: slightly less thorough work might have led to partial or complete failure. Without a firm bottom to the seed-bed white clover establishment would not have been good, and without white clover the rye-grass would not have flourished.

The usual grass mixture for gum land consists of 25 lb. of certified perennial rye-grass, from 5 lb. to 8 lb. of paspalum, 3 lb. of crested dogstail, 2 lb. of red clover, 2 lb. of white clover, and 1 lb. of *Lotus major*—from 38 lb. to 41 lb. per acre. Cocksfoot and timothy are sometimes used in place of part of rye-grass or paspalum seeding, but their use is hardly warranted. Before sowing, most gum land should receive from 10 cwt. to 1 ton of ground limestone, and the seed should be sown with 3 cwt. of superphosphate or basic slag and again top-dressed with from 3 cwt. to 4 cwt. of phosphates four to five months after sowing. There are still large areas of undeveloped gum land, and the two chief causes that have retarded development have been lack of water and the occurrence of kauri resin in the surface soil. The lack of water still limits settlement on these areas, and the digging for kauri-gum has left the surface in a very rough condition for cultivation: the ground was roughly dug up wherever it was suspected that gum existed, and the thin layer of top soil, generally only a couple of inches thick, was buried a foot or more down, and deep holes were dug and left unfilled.

From Taupaki to Helensville the road and railway follow the valley of the Kaipara River. Orchards with their *Pinus radiata* shelter-belts

are common round Taupaki and Kumeu. Eleagnus climbing up pine-trees is used a good deal about here for shelter, and the combination of eleagnus and pine makes a splendid breakwind. Narrow belts of pine soon open up at the bottom and let a strong draught through underneath: the eleagnus fills in the bottom and prevents this. In other districts one sometimes sees poplar and eleagnus shelter-belts, and poplars certainly lend a more pleasing aspect to the countryside than do sombre pines. Trees make a wonderful difference to the countryside, and it is a pity more are not planted. It is the cost of protection fences that really deters farmers from more extensive planting. Much of the charm of the farms on the basic volcanic soil areas of the North is due to the beautiful groves of puriri trees—trees with a sturdy oak-like shape, handsome foliage, and delicately coloured flowers and fruit.

North of Kumeu and Waimauku the country changes—originally forested sandstone hills taking the place of scrub-covered gum land. Large and generally well-grassed farms occur, with Romney sheep on the hills and dairy cows on the flats. Friesian and Shorthorn herds appear as frequently as Jersey herds, and throughout the North Shorthorn herds are fairly common. There are not so many pine-trees about here, and macrocarpa trees and patches of totara and cabbage trees improve the look of the country. Pastures, although closely grazed, look well, but there is no sign yet of hay being fed out. North Auckland farmers do not start winter supplementary feeding as early as the farmers farther south. There is, however, a good deal to be said for early feeding, for, if hay and silage are fed out whilst the grass is still growing, then some fields can be closed to grazing, and the grass growth on these fields saved for early-calving cows in July and early August, and grass at this period is extremely valuable for bringing cows quickly to their maximum production.

At Wharepapa the valley opens out into the tidal stretches of the Kaipara River. To the west of the valley are sand-hills which extend northwards and form the South Head of the Kaipara Harbour. To the west of Helensville lie the Parakai Flats, rich heavy alluvial land in rye-grass pastures—good dairying and fattening country. Many of the best pastures have been tile drained: this work was done a good many years ago and was well worth the expense. Tile drainage has made the land much earlier, and has improved the conditions for winter stocking. I was first here about twelve years ago when some of this tile-draining work was going on. On one farm the fields before draining were covered with quite fair pastures of rye-grass and white clover, but there were wet patches all over the fields that got very boggy in the winter and where pennyroyal grew luxuriantly. Each winter the area of these boggy patches was extended with the trampling of stock. The land had originally been ploughed-in "lands" slightly less than a chain wide, and the tile drains were run up each "finish." This is general practice, for the drain is then placed in the position towards which natural seepage has led the water over a period of years. After laying the tile drains it was this settler's practice to plough, summer-fallow, and resow to grass early in the autumn. In this way he got a new vigorous pasture over the whole field and the full benefit of the drainage. The summer fallow was an important part of the grassing: the seed-bed was moist and firm underneath, and with early sowing the first grazing

took place before the soft recently worked clay soil became really wet with the early winter rains. One sees little tile drainage done nowadays. The cost of the work is the chief deterrent, and paspalum and *Lotus major* are used to grass the wetter areas of heavy flat land where rye-grass and white clover will not flourish.

June 11th, 1934: Helensville to Makarau.—The country is mainly surface-sown sandstone country devoted to sheep and cattle grazing, with the flats and undulating hills devoted to dairying. There is a good deal of reversion to manuka and bracken fern on the hill country. Last autumn's secondary sowings on manuka burns are showing up well on the hillsides. Last season's rise in wool prices has accounted for the renewed attention paid to cleaning up and resowing hill country.

(To be continued.)

APHIDES AFFECTING CULTIVATED PLANTS.

(3) APHIDES OF THE ROSE, CHRYSANTHEMUM, AND ELAEAGNUS.

W. COTTIER, Entomology Section, Plant Research Station, Palmerston North.

OF the aphides infesting the rose in New Zealand there are four common species—viz., *Macrosiphum rosae* Linn., *M. gei* Koch, *Capitophorus rosarum* Kalt., and *C. tetrarhodus* Walk. Those commonly infesting the chrysanthemum are *Macrosiphoniella sanborni* Gill. and *Anuraphis helichrysti* Kalt., while that on *Elaeagnus* is *Capitophorus fragii* Gill.

Throughout the summer there are commonly encountered two forms of each aphid species—viz., the wingless and winged individuals, both being female. These forms reproduce by giving birth to living young and are styled "viviparous" because of this characteristic. In the following accounts these two forms have been described for each species as an aid in identification.

Aphides of the Rose.

The rose plant seems to be particularly susceptible to the attacks of aphides, the young and succulent growth of the shoots in the spring affording excellent feeding-grounds for the pests.

CAPITOPHORUS ROSARUM Kalt.

(*a*) *Wingless Viviparous Female.*—This insect is approximately 2 mm. long, is green in colour, and presents an oval, flattened, elongated appearance. The antennæ, or "feelers," are very short, being only approximately one-third of the length of the body.

(*b*) *Winged Viviparous Female.*—This form is usually somewhat smaller than the wingless female, being approximately 1·5 mm. long. It presents a very dark appearance. The abdomen, however, is green, but is covered by a large dark patch. The antennæ, or "feelers," are very dark and are approximately three-quarters the length of the body.

HOSTS IN NEW ZEALAND.

This aphid has been found only on roses.

OBSERVATIONS.

The species appears on the rose very early in the season; after this period it appears to be scarce. It has not been observed to do any considerable amount of damage in this country.

CAPITOPHORUS TETRARHODUS Walk.

(*a*) *Wingless Viviparous Female.*—This insect is approximately 2 mm. long and is green. It is more robust, however, than the corresponding

FIG. 1. ROSE-BUDS INFESTED BY GREEN APHIS (MACROSIPHUM GEI).

stage of the previous species and does not present the flattened and elongated appearance. The antennæ are somewhat more than half the length of the body, which is covered with numerous knobbed hairs.

(*b*) *Winged Viviparous Female.*—This form is approximately 1·5 mm. long and is very dark in colour. The antennæ are dark and are approximately as long as the body.

HOSTS IN NEW ZEALAND.

This aphid has been found only on roses.

OBSERVATIONS.

This species also appears on roses very early in the spring. Otherwise it appears to be rare and has not been observed to cause great damage.

The wingless viviparous female of this species can be readily distinguished from that of *C. rosarum* by the presence of the numerous knobbed hairs on the former.

MACROSIPHUM ROSAE Linn.

(*a*) *Wingless Viviparous Female.*—The length of this form is approximately 2·5 mm. to 3 mm. The insect is either green or reddish. The antennæ are as long as or longer than the body. The cornicles, or "honey-tubes," at the posterior end of the body are usually black. (For explanation of terms see the preceding article (No. 2) of this series.)

(*b*) *Winged Viviparous Female.*— Length approximately 2·5 mm. to 3 mm.; head and thorax black and the abdomen green with a few black patches; the cornicles and antennæ black, the latter being approximately as long as or a little longer than the body.

HOSTS IN NEW ZEALAND.

Taken from roses and currants.

OBSERVATIONS.

This aphid, together with *M. gei*, is the largest of the family so far found to be present in New Zealand. It is one of the most common rose pests and can be found almost anywhere its host is grown. A characteristic feature of this species is that a colony usually contains red and green individuals. The insect can be found on the rose at almost any time of the year, particularly on the succulent growth of young shoots or flower buds. Although the writer has searched for overwintering eggs of this aphid on rose plants that had been badly infested during the summer, he has as yet been unable to discover the eggs. However, this species can be found living in the summer stages on any scanty rose foliage that may be present on such plants as "ramblers." These observations were made in Palmerston North, but it is very probable that in the colder climates winter eggs are laid.

MACROSIPHUM GEI Koch.

(*a*) *Wingless Viviparous Female.*—The average length of this form is 2·8 mm. to 4 mm., the colour being green. The antennæ are usually longer than the body. The cornicles of this species are usually green with the apices darkened.

(*b*) *Winged Viviparous Female.*—This form varies from 2·9 mm. to 3·3 mm. in length. The head and thorax are usually yellowish-green with the abdomen green. The antennæ are longer than the body, while the cornicles are green with the apices darkened.

HOST-PLANTS IN NEW ZEALAND.

Rose, potato, tomato, *Solanum* sp., *Tulipa* sp., fat hen, *Brassica* spp., *Lychnis* sp., carnations and pinks, *Hebe* sp., nightshade (*Solanum nigrum*), Californian thistle, poppy, chrysanthemum, cineraria, *Cerastium vulgatum* (chickweed), strawberry, dock (*Rumex* spp.), buttercup.

OBSERVATIONS.

This species easily can be distinguished from *M. rosae* by the characters of the cornicles. In *M. gei* these organs are cylindrical and straight, their colour usually being green with the apices darkened. On the other hand, in *M. rosae* the cornicles are black, very commonly curved gently away from each other, and are usually much more noticeably expanded at the base than are those of *M. gei*. The immature forms of *M. gei* are covered by a thin white mealy coating.

M. gei appears abundantly on the young shoots of roses in the early spring. Later it may be found on the potato and others of its hosts. Miss Patch (Bull. 242, Maine Agric. Expt. Sta., 1915) states that in America it passes the winter in the egg-stage on woody plants, the rose being the favourite. Although in New Zealand this aphis does generally appear first on the rose, which fact suggests overwintering eggs, endeavours to find such eggs have so far failed. Another favourite host-plant is the sow-thistle (*Sonchus oleraceus*) and the writer has found the young succulent parts of these plants overcrowded with colonies of *M. gei* in the late autumn. The insect is still on the thistle at the middle and end of the winter, although in much reduced numbers. It has also been found sparsely on "rambler" roses in midwinter. There can be no doubt that the insect can pass the winter in the asexual stage, provided suitable host-plants are available.

Aphides of the Chrysanthemum.

MACROSIPHONIELLA SANBORNI Gill.

(*a*) *Wingless Viviparous Female.*—This form is very dark-brown to black in colour and is very shiny, its average length being approximately 2 mm. The antennæ are approximately as long as the body and, except for a portion near the head, are black.

(*b*) *Winged Viviparous Female.*—Same in colour and size as the wingless form. Antennæ approximately as long as the body.

HOSTS IN NEW ZEALAND.

Chrysanthemum.

OBSERVATIONS.

This aphid is common on chrysanthemum and might be called the characteristic aphid of this plant. It is most frequently found clustered on the young growing shoots and often does great harm to buds. In New Zealand nothing is known of the overwintering habits of this species except that they might breed all through the winter on plants under glass.

ANURAPHIS HELICHRYSTI Kalt.

(*a*) *Wingless Viviparous Female.*—Length of this form 1 mm. to 1·5 mm.; colour green to yellow-green; antennæ yellowish-green and are approximately half the length of the body.

HOSTS IN NEW ZEALAND.

Chrysanthemum, ragwort, ox-eye daisy, plum, red clover, *Cineraria* sp., *Salpiglossis*, sunflower, *Albizzia* sp.

OBSERVATIONS.

This aphid appears to be characteristic of plants of the daisy family. The writer has found it severely damaging ragwort in March in parts of the North Island. Theobald (*Aphididae of Great Britain*, Vol. 2, 1927) states that this is one of the commonest aphides found on plum, frequently causing great damage. In New Zealand the dominant species on the plum is *Rhopalosiphum nymphaeae* Linn., and, as far as our present knowledge allows, *Anuraphis helichrysti* appears to be comparatively unimportant as a pest of this plant. *A. helichrysti* has been known also to cause severe damage in seed-clover crops, the constant sucking of the sap by these small insects preventing the development of the seed-heads.

Nothing is known of the hibernation habits of this insect in New Zealand. In England, however, Theobald (*loc. cit.*) states that eggs are laid in the autumn at the bases of the buds on plum and these do not hatch until the following spring. When hatching occurs the young aphides feed on the developing plum leaves and even blossoms. After living on the plum for two to three months the colony produces winged forms which fly to various herbaceous plants such as clover, ragwort, *Cineraria* sp., &c., and produce colonies which damage their herbaceous hosts.

The Aphid of Elaeagnus.

CAPITOPHORUS BRAGGII Gill.

(*a*) *Wingless Viviparous Female.*—Length approximately 1·5 mm. On the body the ground colour is very light-yellow suffused with purplish pink, and superimposed on this there are several green markings. The antennæ are light to dark and are approximately as long as the body. The head, sides, and posterior portion of the body are covered by conspicuous knobbed hairs.

(*b*) *Winged Viviparous Female.*—Length approximately 1·5 mm. to 2 mm. The head and thorax are dark, while the abdomen is a dirty white colour with a large dark central patch. The antennæ are dark and are slightly longer than the body.

HOSTS IN NEW ZEALAND.

This species has been found breeding only on *Elaeagnus*.

OBSERVATIONS.

This aphid is very widespread in New Zealand. It has been found both in the North and South Islands, wherever *Elaeagnus* hedges are grown. Infested plants become covered with black sooty mould growing on the honey-dew which is given off by the insects, and a very disagreeable odour can be noticed emanating from badly infested hedges.

By May the aphides have laid their black winter eggs at the bases of the buds on the woody parts of *Elaeagnus*, and these remain until the spring when they hatch to carry on the damage caused by these pests.

Control.

An understanding of the habits and hosts of aphid pests will assist greatly in control-measures. For example, with the rose aphides it is known that *Macrosiphum gei* can and does pass the winter in the normal summer form on any rose foliage that is available—*e.g.*, that of

"ramblers"—or on any of its other hosts if sufficient succulent green material is present to furnish a food-supply—*e.g.*, the sow-thistle, *Sonchus oleraceus*. Therefore it behoves those who are interested to see that infestation in the following spring does not come from other hosts, weeds or otherwise. Such hosts can either be removed or cleaned of any aphides by a suitable spray, such as one of those described below. In the summer, too, one should be on the watch to see that infestation is not coming from some other host of the particular aphid concerned.

The most useful material to use as a spray against aphides is nicotine sulphate. This should be used at the rate of 1 part to 800 parts of water in which soap has been previously dissolved at the rate of 3 lb. to 4 lb. per 100 gallons. Soapy water alone, made by dissolving soap at the rate of 3 lb. to 4 lb. per 100 gallons of water, can also be used, but it is a poor substitute for nicotine sulphate. Care should be taken not to make the soap solution too strong, as injury might result to sprayed plants. Summer-grade white oil used at the rate of 1 part to 80–100 parts of water is also an effective spray against aphides, but care must be exercised in its use since it may be liable to damage very tender foliage and flowers. It can generally, however, be applied to rose foliage. A very good but somewhat expensive spray for rose plants before they are in flower is a combination one of nicotine sulphate 1–800 plus summer white oil 1 to 80–100. The oil "tones up" the foliage as well as helping to kill the aphides.

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POTATO-GROWING IN NEW ZEALAND.

II.—DESCRIPTION OF VARIETIES.

R. THOMSON, Assistant in Agronomy, Government Pure-seed Station, Lincoln.

IN describing varieties it is necessary to use certain terms, which require to be understood clearly before the reader can make full use of the descriptions.

The following terms are used:—

HABIT.

A general description of the growth covering.

(*a*) *Height* when grown under average conditions. Tall, 2 ft. or over; medium, 18 in. to 2 ft.; short, below 18 in.

(*b*) *Type of growth* may be "upright," "spreading," or even "straggling."

(*c*) *Vigour* may be described as "strong," "medium," or "poor."

(*d*) *Open or compact growth.*—"Open," when the stems can be seen distinctly through the leaves; "compact," when the foliage is so dense that the stems are not easily observed.

STEM.

(*a*) *Wings.*—These are the projecting ridges which run down the stem, giving it its triangular shape. They may be either waved (crinkled) or straight, and form a useful guide to confirm an identification. Observations should be limited to the upper two or three internodes.

(*b*) *Colour.*—It is very rarely that a stem is totally devoid of colour, and the amount present, although liable to modification according to the amount of light, is a valuable aid to identification. The method used is that devised by Dr. Salaman—namely, an index of 1 to 4. Colour 1 would indicate slight coloration, more especially about ground-level. Colour 4 would represent an entirely deep red purple coloured stem, a very rare condition.

LEAF.

The potato has a compound leaf consisting of a number of leaflets. The colour may vary with the variety, being described as light, medium, or dark green, although the presence of mosaic may very materially effect this characteristic. The leaflets may be widely spaced or bunched together, giving rise to the terms, open or close, and the shape of the leaflets may vary with the variety.

INFLORESCENCE.

(*a*) *The trusses* of flowers may be prominent (carried well above the foliage) or inconspicuous (carried down among the upper leaves) depending upon the length of the flower-stalk.

(*b*) *The flowers* themselves may be numerous, scanty, or rare.

(*c*) *Flower colour* is an important varietal characteristic but one that is modified by hot weather or bright sunlight, and should be observed on a freshly opened flower. Flowers may be white or coloured, the latter being divided into red-heliotrope, blue-heliotrope, or pure blue.

TUBERS.

Although of importance as a guide to identification, the tuber, being subject to modification by environment, is not always a reliable factor in varietal determination.

(*a*) *Skin.*—This may be described as smooth, rough, russet, or scaled.

(*b*) *Colour.*—This should be observed on a freshly dug tuber, as exposure to light often brings out colour in a variety usually classed as a white. Coloured potatoes may be pink (pale red), red, light purple, or deep purple. They may be self-coloured or the colour may be unevenly distributed. Some varieties have splashes of colour round the eyes, while in others the colour may cover the rest of the tuber leaving the skin round the eye white.

(*c*) *Shape.*—This characteristic is greatly modified by soil and rainfall, and it is extremely difficult to fix a standard.

The following terms are used in these notes:—

Round: Such tubers are as long as they are broad, but may be more or less flattened. There is usually a depression at the heel end.

Long: Potatoes of this type may be either finger-shaped or cylindrical. The finger-shaped is tapering and often hooked at the heel, as in Black Kidney. The cylindrical type is of more or less equal diameter throughout its length. Kidney-shaped tubers are generally broad in the middle, tapering to both ends. They may sometimes be pear-shaped.

Oval: Describes a short kidney.

(*d*) *Flesh Colour.*—This is described as white, lemon (pale yellow), or yellow. The colour present in the skin may sometimes be present in the flesh, particularly near the eyes.

(*e*) *Eyes.*—These may be deep, medium, or shallow. They may be evenly distributed or mainly at the rose end. In some cases the eyes are coloured, and also the skin surrounding them.

(*f*) *Sprouts.*—Sprout colour is a very definite characteristic, although the intensity of the colouring is modified by the amount of light. The terms used in the following notes are pink, deep pink, purple, deep purple.

MATURITY.

Varieties are described as "first early," "second early," "early main crop," "main crop," and "late main crop."

SUMMARY OF VARIETIES WHICH HAVE BEEN GROWN IN NEW ZEALAND.

Variety.	Maturity.	Skin Colour.
(1) Varieties of Importance in the New Zealand Trade.		
Arran Banner	Early main crop	White.
Arran Chief	Late main crop	,,
Aucklander Short Top	Early main crop	,,
Aucklander Tall Top	Late main crop	,,
Bresee's Prolific	Early main crop	,,
Dakota	Late main crop	Red.
Epicure	First early	White.
Iron Duke	Late main crop	,,
King Edward VII	Early main crop	Red and white.
Northern Star	Late main crop	White.
(2) Varieties of Lesser Importance in the New Zealand Trade.		
Ally	Late second early	White.
Arran Consul	Main crop	,,
Arran Pilot	First early	,,
American Wonder	Main crop	,,
Brownells	Main crop	Pink.
Endurance	Early main crop	White.
Early Regent	First early	,,
Early Rose	Second early	Pink.
Field Marshal	Main crop	White.
Great Scot	Early main crop	White.
Kerr's Pink	Late main crop	Pink.
Majestic	Early main crop	White.
Maori Chief	Late main crop	Mottled blue and white.
Sharpe's Express	First early	White.
Up-to-Date	Main crop	,,
(3) Varieties of no Importance.		
Arran Comrade	Second early	White.
Arran Crest	First early	,,
Arran Victory	Main Crop	Blue.
British Queen	Second early	White.
Burbank	Main crop	,,
Duke of York	First early	Yellow.
Gold Coin	Main crop	White.
Herald	Second early	,
Incomer	Late main crop	,,
Irish Cobbler	First early	,,
Leader	Main crop	Red.
New Era	Early main crop	White.
Reading Russet	Second early	Red.
Sefton Wonder	Early main crop	White.
Scotia	Main crop	Red.
(4) Varieties of Little or no Importance in the New Zealand Trade, but of some Value for Garden Culture.		
Abundance	Early main crop	White.
Beauty of Hebron	Second early	Pink.
Beauty of Hebron (N.Z.)	Early main crop	Mottled pink.
Black Kidney	First early	Blue.
Catriona	Second early	White splashed purple.
Chas. Downing	Second early	White.
Di-Vernon	First early	White mottled purple.
Eclipse	First early	White.
Early Puritan	First early	,,
Golden Wonder	Late main crop	Russet brown.
Jersey Bennes	First early	White.
May Queen	First early	,,
N.Z. White Elephant	Late main crop	,,
Robin Adair	Second early	Red.
Witchill	First early	White.

ABUNDANCE.

Origin.—Magnum Bonum X Fox's Seedling, raised by J. Clark, and introduced by Sutton and Sons in 1886.

Foliage.—Haulm tall, upright, vigorous, compact. Stem branching, wings waved, colour 2 (bronze). Leaf dark green and glossy, arched; secondary leaflets numerous and large, giving the leaf a crowded appearance.

Flower.—White, large, and numerous, carried well above the foliage.

Tubers.—Oval to round, somewhat flat. Eyes shallow. Eyebrow distinct, long. There is generally a blue-purple coloration at the heel end and on the runners during the growing-season. Flesh clear white. Sprouts blue.

Maturity.—Early main crop.

Notes.—A variety which has been extremely popular in the past, mainly perhaps, on account of the attractive shape of the tubers combined with an average good yield. It has been a very popular exhibition variety. It is now practically out of cultivation in this country, as is evidenced by the fact that it has not in any year been entered in certification. Its popularity led to numerous synonyms being put on the market. It is very susceptible to late blight. No good purpose would be served by introducing it once again into general cultivation.

ALLY.

Origin.—Raised by D. MacKelvie, Lamlash, in 1907. First named Arran Treasure, but on account of its inferior table quality was not put on the market. In 1915 it was reintroduced under its present name by Messrs. Poad and others.

Foliage.—Haulm medium height and vigour, spreading, dense. Stem, colour 1 only at base; wings straight. Leaf dark greyish-green; leaflets large and pointed; secondaries few and small.

Flower.—White and scanty; flower-stalk short; anthers malformed.

Tubers.—Round to oval, flat. Eyes shallow. Skin somewhat yellow. Flesh white. Sprouts pink.

Maturity.—Late second early.

Notes.—This variety was popular for a while on account of a combination of comparative earliness with an excellent shape and firm skin. It is still grown to a limited extent and certified seed is available. It is not recommended for general cultivation, and could be well replaced with Aucklander Short Top, which can be marketed just as early and gives a greater yield if left to mature. The cooking quality of Ally is very poor.

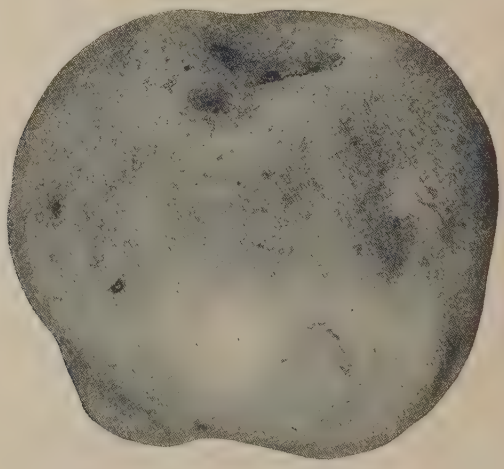

FIG. 5. ARRAN BANNER.

ARRAN BANNER.

Origin.—Raised by D. MacKelvie, Lamlash, and introduced in 1926–27. For several seasons the seed commanded a very high price.

Foliage.—Haulm tall, vigorous, open, semi-erect, later becoming spreading. Stem, thick; colour, 0–1, bronzing in axils. Wing slightly crinkled. Leaf open, large, greyish-green colour, soft, wrinkled, dull appearance; secondaries large.

Flower.—White, rare; buds drop off; anthers malformed; flower-stalks very short.

Tubers.—Round, slightly flattened; skin white. Eyes medium to shallow, rose end deep. Eyebrow distinct. Flesh white. Sprouts pink.

Maturity.—Early main crop.

Notes.—A comparatively new variety. It is a heavy cropper, producing a large proportion of table-sized tubers. It should not be grown on rich land, as the tubers grow very large and are subject to hollow heart. On such land the rose end also becomes very deep. Certified seed is available, and the good shape and heavy cropping ability make it a variety well worth growing. Reports indicate that the seed stocks require careful attention to keep them free from mosaic. In New Zealand it has a very wide range of adaptability, but its popularity has received a check on account of the variety being grown on land that is too heavy.

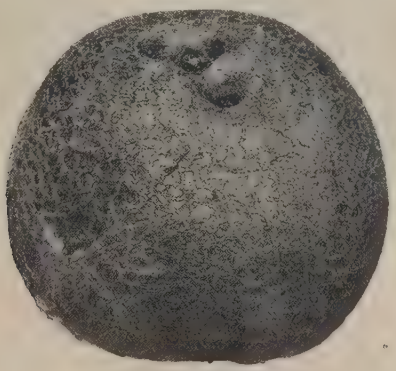

FIG. 6. ARRAN CHIEF.

ARRAN CHIEF.

Origin.—Raised by D. MacKelvie, Lamlash, in 1907, and introduced by him into commerce in 1911.

Foliage.—Haulm tall, upright, and open, vigorous. Stem, colour 1–2, mottled. Wings very waved. Leaf medium to dark green, open and rigid; leaflets wrinkled, small, margin often waved.

Flower.—Inconspicuous, scanty, white with green tips, drop readily in the bud stage. Anthers pale and malformed.

Tubers.—Round and somewhat flat. Skin white and somewhat rough, often with a purple spot at heel end. Eyes medium, clustered towards upper rose end. Flesh white. Sprouts deep purple.

Maturity.—Late main crop.

Notes.—This variety is well known. It is excellently adapted for medium to heavy potato land on account of its good shape and excellent handling qualities. Unfortunately it is somewhat susceptible to late blight. Northern Star is a common rogue, but plenty of certified seed is available.

ARRAN COMRADE.

Origin.—Raised and introduced by D. MacKelvie, Lamlash, in 1918.

Foliage.—Haulm medium height, compact, and spreading; typical drooping appearance towards maturity. Stem practically colourless. Wings straight. Leaf open, drooping, soft grey-green; leaflets large, pointed; secondaries well developed.

Flower.—White, fairly numerous; flower-stalk long.

Tubers.—Flattened round, very even. Skin white. Eyes shallow. Flesh white. Sprouts purple.

Maturity.—Second early.

Notes.—Only an exhibition variety. Too subject to late blight and leaf-roll to be a commercial success.

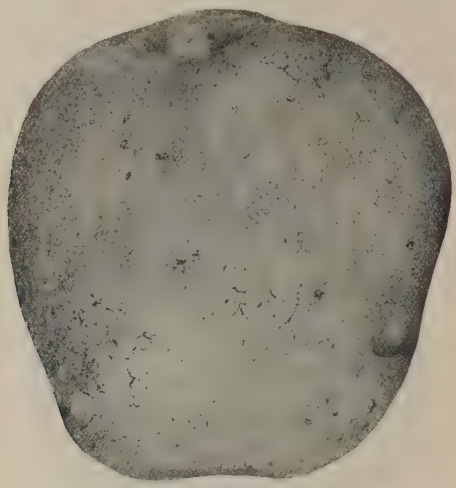

FIG. 7. ARRAN CONSUL.

ARRAN CONSUL.

Origin.—Raised by D. MacKelvie, Lamlash, and introduced into commerce in 1924.

Foliage.—Haulm tall, vigorous, upright, and open; rather sparse. Stem, colour 0–1. Wings straight. Leaf very open, long, drooping; leaflet medium green, narrow, pointed, hairy; secondaries well developed.

Flower.—White, rare; buds drop readily; dark-coloured.

Tubers.—Short oval (oblong). Eyes shallow, rose end medium deep. Skin white and slightly coarse. Flesh white. Sprouts pink.

Maturity.—Main crop.

Notes.—This variety deserves to be grown more than is the case at present. It is a good cropper and the shape is good. Its keeping qualities are outstanding, being equal to if not better than Dakota. As it is very slow to sprout, the tubers keep in the pits till late in the season with very little loss. It is distinguished by the very slow early growth, and the very open, almost spindly, foliage. Certified seed is available.

ARRAN CREST.

Origin.—Raised by D. MacKelvie, Lamlash, and introduced in 1928–29.

Foliage.—Haulm dwarf and open, spreading, and moderately vigorous. Stem, colour 1, bronzing at base. Wings straight. Leaf open, long, and drooping; leaflets dark green, long, and narrow; secondaries well developed, pointed; not numerous.

Flower.—White, very rare, buds drop readily; flower-stalks very short.

Tubers.—Round. Eyes medium to deep. Eyebrow distinct. Skin white. Flesh white. Sprouts pink.

Maturity.—First early.

Notes.—Received prominence in Great Britain on account of its earliness and immunity to wart disease. Local trials have indicated that it cannot compete with Epicure, and that it is very susceptible to virus. No certified seed is available, and the variety is not recommended.

ARRAN PILOT.

Origin.—Raised by D. MacKelvie, Lamlash, and introduced in 1930–31.

Foliage.—Haulm medium height, spreading, later straggling. Stem, colour 1–2; fairly numerous. Wing broad. Leaf open, rigid, dark-green midrib tinged purple at base; leaflets broad.

Flower.—Blue-purple tipped white, infrequent; flower-stalk short.

Tubers.—Kidney. Eyes shallow, mostly on point of tuber. Eyebrow indistinct. Skin white. Flesh white. Sprout purple.

Maturity.—First early.

Notes.—Has been tried only to a very limited extent in this country. It appears to crop well for a first early, and its excellent shape makes it very promising. No certified seed is available at present.

ARRAN VICTORY.

Origin.—Raised by D. MacKelvie, Lamlash, in 1912, and introduced by him in 1918.

Foliage.—Haulm tall, vigorous, upright, and open. Stem, colour 4, extending into midribs of leaves. Wing slightly crinkled. Leaf, dark green, open; leaflet large, pointed; terminal leaflet drooping.

Flower.—Creamy white, numerous; flower-stalk medium long, buds purple, hairy.

Tubers.—Round to slightly oval. Eyes medium. Eyebrow distinct. Skin purple. Flesh white. Sprouts purple; sprouts early.

Maturity.—Main crop.

Notes.—On account of its blue skin this variety is not likely to become of commercial importance in this country. It is a good cropper, of good quality, and a fair keeper. It is rather susceptible to leaf-roll and internal brown fleck. No certified seed is available.

AMERICAN WONDER.

Origin.—Not known. The variety corresponds very closely with the "Rural" group described by Stuart, in which case it is probably of American origin, and may be one of the chief late crop varieties renamed.

Foliage.—Haulm tall, vigorous, upright, and open; centre stem distinctly upright. Stem somewhat branched, colour 2; streaked. Leaf dark green, small; leaflets crinkled and leathery, medium size, rounded; secondaries intermediate.

Flower.—Purple, with colour getting paler from centre to outside; moderately numerous. Flower-stalk medium.

Tuber.—Round to oblong, much flattened. Skin white and smooth. Eyes shallow, and mainly on upper surface at rose end. Flesh white. Sprouts blue.

Maturity.—Main to late crop.

Notes.—Crops well but has been tried out to only a limited extent.

AUCKLANDER SHORT TOP.

Origin.—Selected from a crop of Sutton's Supreme by Mr. A. J. Rich and Mr. M. Laws, of Kaiapoi. Introduced into commerce by Mr. Rich in 1910, and named by Mr. Laws.

Foliage.—Haulm vigorous, open, medium height, moderately spreading but stiff. Stem, colour 2. Wings slightly waved. Leaf medium dark green; leaflets small and crinkled.

Flower.—White, scanty; flower-stalk medium height.

Tubers.—Oval to kidney. Skin creamy-white, clear, and smooth; very thin and easily bruised. Flesh white. Eyes medium to shallow. Sprouts pale pink.

Maturity.—Second early to early main crop.

Notes.—Is the most popular variety grown in New Zealand, and can be recommended over a wide range of conditions. An excellent cropper of good

shape and very fine quality, producing a very high proportion of table-sized tubers. Its one fault is its clear thin skin which bruises easily and shows the least trace of scab. Certified seed is available and always commands a high price.

See Aucklander Tall Top for the differences between two Aucklander varieties.

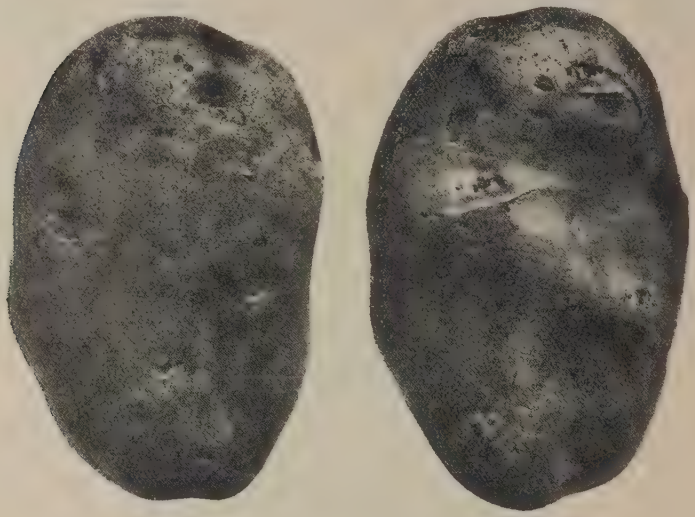

FIG. 8. AUCKLANDER SHORT TOP (LEFT) AND TALL TOP (RIGHT).

(To be continued.)

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USE OF LIMONITE IN BUSH-SICKNESS.

INFLUENCE OF COBALT CONTENT.

R. E. R. GRIMMETT and F. B. SHORLAND, Chemistry Section, Department of Agriculture, Wellington.

FOLLOWING Filmer and Underwood's* claim that iron-free extracts of limonite cured enzootic marasmus in Western Australia it was decided in August, 1934, to investigate the iron-free extracts of New Zealand limonites, used in the cure of bush-sickness, prepared in accordance with Filmer and Underwood's method. Half a hundredweight of Ruatangata limonite known to be effective was extracted twice with from 10 to 12 litres of decinormal HCl by standing in the cold overnight with occasional shaking. After filtration and concentration and removal of iron and silica the solution developed a bright green colour, which was found to be due to cobalt: 3·75 mg. of cobalt was found to be present in the first extract, but as the degree of acidity had been much reduced by the small amount of lime present in the large bulk of limonite a further extract was made and found to have 60 mg. of cobalt present. Feeding-trials with "bush-sick" animals have been made with these extracts. The first extract gave negative results with one sheep each at Atiamuri and Mamaku, while the second extract is showing slow improvement with the same sheep—not nearly so fast as with the whole limonite. A solution of cobalt acetate fed to a sick cow at Kaharoa gave negative results, but it is not certain whether the animal was truly "bush-sick" and not poisoned with ragwort. The same solution is now being fed at Atiamuri to a sick sheep, which is slowly improving. At the same time, another very sick sheep is definitely improving on a solution of iron ammonium citrate prepared from A.R. iron-ammonium sulphate by a process specially designed to remove cobalt and other trace elements, and and from distilled ethyl citrate and ammonia. It thus appears that trace elements such as cobalt may exert a stimulating effect, or aid iron assimilation, but that iron *per se* is required, and is curative. Another trace element present in the iron-free extract of Ruatangata limonite is zinc, and a similar small experiment in this case is also showing slow improvement in a sick sheep. The field experiments to which reference has been made are in the hands of Mr. C. R. Taylor, of the Chemistry Section.

For a statement regarding the possible stimulating effects of trace elements such as arsenic and copper, see Aston, *N.Z. Journal of Agriculture*, 49, 1934, pages 84–85. Recent work has shown that the *cause* of bush sickness is not connected with a deficiency of either of these particular elements.

* Filmer, J. F. and Underwood, E. J., "Enzootic Marasmus: Treatment with Limonite Fractions," *Australian Veterinary Journal*, Vol. X, 1934, 83–92.

Tables published in the August *Abstract of Statistics* show that in 1933–34, in all, 7,570 holdings of 1 acre or more situated outside boroughs grew wheat for threshing. The average area on a holding was 37·82 acres and the average yield per acre was 31·56 bushels.

SEED-WHEAT CERTIFICATION.

CERTIFIED CROPS.

UNDER the Government scheme for the certification of seed wheat, the following additional growers have seed for sale from crops which have passed both field and grain inspections. (Previous lists, to which growers are referred, were published in this *Journal* in February, March, April, and May, 1935) :—

Variety.	Grower.	Acreage.
Cross 7	*J. Brooks, Brookside	17
Hunter's II ..	C. G. Verity, Waihao Forks	7
Solid Straw Tuscan	†H. P. Brosnahan, Seadown, R.M.D. ..	5
	†R. Harris, Opaki Road, Masterton ..	10
	†F. S. Medlicott, Waimate, R.M.D. ..	19

* Contract to Canterbury Seed Co. † Passed subject to machine-dressing.

—*Fields Division.*

The difference between sowing pastures down with and without a good companion crop was very noticeable recently on a farm at Waikaka. Rape was sown at the same time as the grass-seed, but in one fairly long run the rape-seed stopped running and the grass seed only was sown. On this part the sward is quite dense, while the other part is quite open. Sheep appear to appreciate the dense sward as regards grazing.

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THE FARM.

Top-dressing in Relation to Production Costs.

A QUESTION which continues to be asked very much is whether expenditure on top-dressing is one of the items of overhead cost which it is advisable to reduce. The general answer given to the question by farmers favours continuance of top-dressing. This is indicated by the relatively heavy top-dressing programme which has been maintained during recent difficult trying years. Certainly some decline in top-dressing has taken place, but often farmers adopted a policy of straining their resources in order to obtain the assistance which they considered top-dressing would give. That such a policy has undoubted merit is indicated by data published in the report of the Dairy Industry Commission. A table appearing on page 16 of that report indicates that—

(1) When the butterfat-production was under 75 lb. an acre the expenditure in fertilizers was 5s. 8d. an acre, and the cost of fertilizer per pound of butterfat was 1·193d.

(2) When the butterfat-production ranged from 125 lb. to 150 lb. an acre the expenditure on fertilizer was 10s. 9d. per acre, and the cost of fertilizer per pound of butterfat was 0·943d.

(3) When the butterfat-production ranged from 200 lb. to 225 lb. an acre the expenditure on fertilizer was 14s. 8d. an acre, and the cost of fertilizer per pound of butterfat was 0·839d.

(4) When the butterfat-production was 250 lb. an acre and over the expenditure on fertilizer was 18s. 10d. an acre, and the cost of fertilizer per pound of butterfat was 0·803d.

These data, which relate to the 1933–34 season, are based on the information supplied to the Department of Agriculture by 550 North Island dairy-farmers. Information typical of the industry was sought, and the results that were considered proved to be typical ones, being however, somewhat better than the average. The farms reviewed were located principally as follows: 144 in Wellington Province, 86 in Taranaki, 144 in South Auckland, 115 in North Auckland. Summed up, on the farms covered by the survey liberal use of fertilizer was associated with substantially increased production and decreased overhead in respect to the cost of fertilizer as an item in the cost of a pound of butterfat. It may be noted, for instance, that in the comparisons cited above the overhead for fertilizer is 48 per cent. higher with light use of fertilizer than the relatively liberal use (1·193d. in the former case in comparison with 0·803d. a pound of butterfat in the latter case). While it cannot be deduced logically from the evidence under review that freer use of fertilizer always results in lower overhead costs in dairying, it does seem clear from the data given that many farmers in their fertilizer practice do not even approximate the probable limitations in the amount of fertilizer that may be used profitably, and that indeed there are those who use fertilizers to such a restricted extent that they hardly provide themselves with proper evidence about the results obtainable from judicious top-dressing.

It is relevant to the above considerations that the raising of fat lambs is analogous to dairying in that it is based primarily on the production of milk. As is to be expected from this, experience shows that the reaction to top-dressing is similar, whether the resultant supply of feed be devoted

to the production of butterfat or of fat lambs. In fact, normally, the influence of fertilizer can be turned into cash more certainly and more readily in the raising of fat lambs then in dairying: this is because in raising fat lambs the season of the need of additional milk-producing feed often coincides more completely than in dairying with the production of additional milk-producing feed due to top-dressing—much of the benefit of popular top-dressing results in additional fresh leafy feed in spring and summer just when the crop of lambs need the nutriment obtainable from such feed either directly or indirectly through the ewes.

Time of Phosphatic Top-dressing.

Repeatedly in these notes attention has been directed to specific advantages attaching to top-dressing with phosphates in the autumn and at times in the summer. Summed up, the main advantage of such top-dressing is not that it gives a greater supply of feed than top-dressing in the winter or spring, but that it gives a supply of feed which, because of its more even production through the year, more easily can be used effectively. Actually, varying the date of applying phosphatic fertilizer to grassland seems not to affect appreciably the amount of additional feed which results. This matter has been investigated in a limited amount of work which has been carried out in both Auckland and Wellington Provinces, and in which the pasture-growth was weighed carefully at frequent intervals. It was found, for instance, that when superphosphate at the rate of 3 cwt. an acre was applied variously in spring to one area, in summer to another, and in autumn and in winter to others, there was practically no difference in the amount of additional feed resulting in a full year on the various areas. Much the same result was obtained when the date of application of basic slag at 3 cwt. an acre was similarly varied, except that in the use of basic slag the winter (June) application consistently was slightly superior. These results are in full accord with prolonged experience in many districts where it has been found that top-dressing with phosphates may be carried out in July with good results. Where, as so often is the case, it is desired to stimulate growth rapidly, then generally superphosphate should be used. Even on somewhat cold soils in the North Island, superphosphate applied in July has been found to bring about quite appreciable increases in the amount of feed available in August. Basic slag applied at this season is considerably slower in its action than superphosphate, but somewhat quicker than island and African phosphates.

Spring Top-dressing with Sulphate of Ammonia.

During recent years much consideration has been given to the application of sulphate of ammonia to grassland in the spring. In this connection the available knowledge makes it unsafe to lay down any rules for general application. Of two adjacent similar farms on one the use of sulphate of ammonia in the spring may be well justified, while it is not on the other—much depends on the prior management. When there is prospect of scant supplies of feed in August and September, generally additional feed may be obtained by the application of sulphate of ammonia about mid-July to suitable pastures. For a few weeks prior to mid-July it is probably advisable not to apply sulphate of ammonia, for it has been found not to exert much influence when plants naturally are most dormant because of cold conditions. The use of superphosphate in conjunction with sulphate of ammonia is generally advisable, and is commonly effected by the use of the fertilizer known as ammoniated superphosphate. If the pasture to which sulphate of ammonia is applied contains a considerable proportion of rye-grass and is well drained, there is greater likelihood of successful results. Frequently liming also should be associated with the use of sulphate of ammonia, even in places where no visible result from liming, alone or in conjunction with superphosphate, has been noted.

Miscellaneous Attention to Grassland.

Generally in July harrowing of pastures which have not been harrowed recently should be carried out. It is particularly advisable on fields which have been stocked heavily in May and June. Such harrowing may be made of great value in breaking up and distributing animal-droppings, and as an aid in this a section of chain-harrow attached behind the grass-harrow proper is usually valuable.

Suitable paddocks, such as ones which are well drained, provided with shelter, and containing a substantial amount of rye-grass, often should be closed up during July for subsequent reception of cows that calve early or of ewes that lamb early.

At times, and especially in districts characterized by heavy soils, a wet winter is followed in the next summer by the occurrence of hosts of weeds in pastures which previously were relatively free from them. Thistles, rushes, buttercups, and daisies are among such weeds. These weeds gain their foothold on bare patches of the soil which have resulted from the trampling of stock on wet soft fields. Young pastures particularly are subject to such damage, which at times it is not at all easy to avoid in practice. One course is to avoid as far as possible the stocking of those portions of the farm which are most subject to damage from trampling during a wet period. Another course is to concentrate the damage as far as possible in paddocks which soon are to be used for arable cropping—these may well include paddocks which have suffered from the ravages of the grass-grub.

Drainage.

Certain aspects of farm drainage frequently obtrude themselves. First is the fact that the returns from certain sound practices, such as the use of fertilizer or of good seed, are at times much smaller than they would be were these practices applied to well-drained land. In the next place, drainage could often be improved materially, even though it would not be made nearly perfect, at a comparatively small cost—in some cases, for instance, the drainage of certain wet parts which catch the moisture from larger areas would give benefit out of all proportion to its cost. A further matter worthy of note is that money may readily be wasted on drainage unless it is both well planned and well executed. Though drainage is a relatively simple matter, it is not so simple as to be without pitfalls to the inexperienced, and so those without experience, as a common-sense measure, should seek guidance based on experience. Still another matter that calls for note is embodied in the view that all other effort towards improvement should be deferred until the drainage is rectified. This is fairly commonly reflected in the attitude that top-dressing is inadvisable until the land has been drained. Actually top-dressing is often distinctly profitable on poorly drained land, on which it would be more profitable were the drainage better. Similarly, instead of waiting for good drainage to enable a high-class seed mixture of the rye-grass - cocksfoot - white-clover type to be sown with success, it is at times a good policy to establish species which not only will tolerate badly drained conditions, but also yield satisfactory supplies of feed. This may mean resorting to the use of such species as meadow foxtail, *Poa trivialis*, *Lotus major*, strawberry clover, and sweet floating-grass, according to the conditions. Detailed information about suitable plants for badly drained situations may be obtained from local officers of the Fields Division.

The following general facts about drainage are at times overlooked :—

(1) The drainage of wet spots in a field is often the most profitable form of drainage that can be undertaken. In the drainage of isolated wet spots an endeavour should be made—particularly if tile drains are being employed—to locate the drains so that they may serve as part of any subsequent more comprehensive work and probably be the basis of it.

(2) In planning drainage work, the first step should be the locating of the source of the supply of excessive water. Knowledge of the source may reveal the possibility of draining an area more satisfactorily by preventing water reaching it instead of by removing water subsequently. Wet areas along hillsides or at the foot of hills often offer opportunity for the use of drains placed to intercept water in its passage to badly drained land. Drainage by interception frequently is relatively inexpensive.

(3) When tile drainage is to be provided, this should be done when the land is in grass. Then the sods of turf may be set aside for subsequent placing, with the turf down, on the joints between the tiles. Sods are of value also at the mouths of any mole drains which discharge into tiles.

(4) It is preferable not to lay tiles until the ditch has been freed of any silty material by a heavy rain.

(5) After the tiles have been placed the ditch should be filled in as soon as possible.

(6) The bottom of the ditch should be rounded and as far as possible should fit the diameter of the tile being used—this assists in avoiding displacement.

(7) A minimum diameter of 3 in. in tiles may well be adopted.

(8) In laying tiles it is particularly desirable to make them fit at the top.

(9) A useful general rule as to the depth of mole drains is to place them in the subsoil, but not more deeply than is necessary to avoid the comparatively crumbly surface soil. This depth should be determined not by the average thickness of the more open surface layer, but by its greatest thickness—otherwise the mole drain would collapse after a relatively short time in those portions of it passing through the more open soil.

(10) The heavier the land the closer should be the mole drains—usually it is not advisable to place mole drains farther apart than 9 ft., and often more profitable results would be obtained from drains 6 ft. apart.

(11) Mole drains, like other drains, function properly only if kept open at the mouths. If mole drains discharge through firm subsoil into open drains it is likely to be necessary only to inspect the mouths of moles at intervals to remove any blockages. But when moles discharge along a natural hillside terrace the openings usually are in crumbly earth which tends to obstruct the discharge of water unless proper measures are taken. One measure is to dig a ditch at the mouth of each mole until solid subsoil is reached, then lay tiles from this to the point of actual discharge and fill in the ditch.

(12) It is not advisable to employ mole drains on steep grades, where scouring would occur, or on extremely level ground. They function satisfactorily when there is a fall of from 3 in. to 4 in. in 100 ft.

(13) Level sections or depressions in mole drains involve the danger of silting, and so mole drains should pass round instead of across depressions.

(14) Mole drains usually should be made in early winter, after the subsoil has become well moistened: if the subsoil is too dry cracking of the walls, which leads to later blocking, may occur; if the subsoil is too wet a glazed wall, which means slower drainage, may result.

General Cropping.

In general, sowing of seed in July should be avoided. Spring-sown oats and wheat generally are sown in August or in early September and barley in September or early October. The cultivation for cereals which are to follow swedes or turnips—crops which often are on the land till the end of July or early August—must be pushed ahead as quickly as is possible with due regard to the undesirable effects that may come from tillage of soil containing too much water. Glazed furrows and soil clinging to boots or implements are indicative of over-wet soils. For such crops the roller can

be used advantageously on light land in consolidating the seed-bed, but on heavy lands rolling may be harmful—it may cause the soil to settle down too much and to cake. Cereals sown in the spring benefit from a rolling after drilling of the seed, but, unless the land is light, the rolling should be carried out not immediately after drilling but when the land is drier—*e.g.*, in September or early October.

As a rule cereals sown in the spring respond well to phosphates, and a dressing of 1 cwt. an acre of superphosphate in drier districts or of from 2 cwt. to 2½ cwt. an acre in districts of good rainfall may be expected to prove profitable.

If the preparatory cultivation for lucerne is not already in progress it should be commenced at an early date. Lucerne following old pasture is particularly good practice, and if it is adopted then the land should be prepared in the manner described in these notes last month.

A somewhat common misconception is that lucerne is comparatively fastidious or exacting in its requirements. Widespread field experience in New Zealand and in other countries has shown that lucerne may be grown profitably over a wide range of conditions of soil and climate provided the soils are well drained. Land which has been under the plough should be sown in lucerne only if it has been kept "clean" while in an arable state, either by fallowing, by the growing of fallow crops such as mangels and potatoes, which have really cleaned the ground, or by the growing of "smothering" crops such as oats and tares, which weaken weeds.

Winter Feeding of Stock.

Cereals sown in the autumn should be fed off before growth becomes too long. As a rule two feedings of relatively long growth are more satisfactory than a single feeding of long heavy growth, in which considerable waste is practically unavoidable. Garton oats should be eaten down once, and that quickly.

In the feeding of roots, carrots and mangels should follow swedes in the order named. Chou moellier usually is in good condition for feeding in July, when, as a rule, it should be used, for sometimes in August it tends to run to seed-stalks. Because of the watery nature of both roots and silage, it is better to feed roots and hay than roots alone, or roots and silage. The prolonged feeding of roots alone has led to disorders such as red-water.

In the feeding of stock July is generally a critical period, and especially is this true relative to developing stock and to dairy cows and breeding-ewes. Many should know from bitter experience that poor feeding of the dairy cow after calving has a dire effect upon the season's yield. It does not seem to be so well known that during the time the dairy cow is not yielding milk she should be fed liberally enough to build up bodily reserves which are drawn upon in the subsequent producing-season and which assist in minimizing the incidence of disorders that occur all too commonly at about calving-time.

Recent New Zealand work has shown that the economical production of fat lambs is determined to a considerable extent by obtaining lambs of satisfactory weight at birth, and that the weight of lambs at birth in its turn is determined by the feeding of the ewes during the winter. Further, extensive work shows that a completely analogous position obtains in pig-raising.

While it may be difficult to make economic emergency provision of feed for the current winter, the above facts provide guidance as to the steps relative to special feed provision which should be taken in preparation for future winters.

R. P. Connell, Fields Division, Palmerston North.

THE ORCHARD.

Manures and Cover Crops.

THE following elementary facts regarding the fertility of the soil must be given their due consideration before any system of manuring is decided upon. Soils are made up of inorganic matter (minerals) and organic matter, which might generally be termed decayed vegetable or animal matter. In the latter is contained most of the nitrogen. Impoverished conditions in the soil may be brought about by improper cultural practices, unfavourable weather, or by continuous cropping with the same class of plant. Excessive cultivation, especially during dry periods, will rapidly destroy the organic matter in the soil and so dissipate the supply of nitrogen. Three substances essential in soil-fertility are nitrogen, phosphoric acid, and potash. These three substances combined in one material are what is commonly known as a complete manure.

As the soil texture and fertility vary in different localities, so must the application of manures be varied if the best results are to be obtained. A liberal supply of humus (decomposed organic matter) is probably one of the most important factors in promoting healthy tree-growth. One of the best ways of supplying humus is in the form of farmyard manure. However, as farmyard manure is seldom available in sufficient quantities for general application, cover-cropping has to be resorted to. In the use of leguminous crops, such as lupins, peas, beans, vetches, and clover, a considerable amount of nitrogen is obtained from the air, and a soil liberally supplied with the humus resulting from the decay of such crops is also well supplied with nitrogen. Humus also holds stores of phosphoric acid and potash, as well as of nitrogen, which during the process of decomposition are liberated as plant foods. Humus increases the absorptive and retentive powers of the soil with regard to moisture, it opens up stiff soils and binds light ones, and is a potent factor in preventing the loss of manurial materials by drainage. Legumes are of greater value than cereals as a cover-crop in that they not only gather from the air nitrogen—which is stored in nodules in the roots—but are deeper-rooting and are able to avail themselves of food-supply from the subsoil.

Where additional fertility is required, fertilizers can be added. In most instances where trees are making poor growth and the fruit is small it may be taken that nitrogen is required. This can be supplied in the form of sulphate of ammonia. For bearing trees about 2 lb. per tree is recommended, and this should be worked into the soil as the spring growth is commencing. The excessive use of sulphate of ammonia will tend to delay the colouring of the fruit in certain varieties, including Jonathan. It should be noted that the use of this material increases the acidity of the soil. This condition can be corrected or prevented by the use of 1½ lb. of lime to every 1 lb. of the fertilizer.

Phosphoric acid usually is applied in the form of superphosphate, and potash in the form of sulphate of potash. As these fertilizers are of comparatively slow action they should be applied several months before the spring growth commences. A portion should also be applied with the sowing of the cover-crop. The amount to apply per acre will vary according to the needs of the trees. From 2 lb. to 6 lb. or more per tree for superphosphate and one-half of this amount for sulphate of potash are quantities in fairly general use. However, on certain soils and with certain classes of fruit-trees the application of phosphoric acid and potash is of doubtful value, and the advice of the Orchard Instructor for the district should be sought before deciding on any manurial programme.

Pear-tree Pruning.

To induce vigorous-growing Winter Cole and Winter Nelis pear-trees to carry heavy annual crops, the greatest success has resulted from very

hard pruning. This treatment, in most cases, consists of a drastic reduction in the number of leaders and fruiting-arms, and heavy thinning of fruiting branches and spurs, and a hard cutting of the current season's growth. Where this treatment has been given and followed up with similar pruning each year, heavy annual crops have been general.

Grafting.

The scions for grafting should be selected at pruning-time from trees of known bearing habits, the wood should be well ripened, free from pests and diseases, and should be of the past year's growth. As the scions will not be required for some time, they may be kept in good condition by being laid on the ground in a shady situation and kept covered with a damp sack.

—P. Everett, Orchard Instructor, Gisborne.

Citrus Notes.

Now that the winter months are upon us, growers are again reminded to prepare for the danger of frost damage in those localities where frost is likely to occur. Instructions in the means of combating frost have been given from time to time in previous notes.

Another important work which calls for attention at this time of the year is the guarding against excess water at the roots of established citrus trees. Under-drainage is one of the principal essentials, and even where this is considered to be adequate excess water is apt to accumulate during the rainy season. The removal of excessive water can be accomplished by opening up a furrow from low-lying areas, or by the use of a temporary drain made with a spade.

The harvesting of lemons which have attained the correct size should now be done, and the fruits put away for curing and storage. At this season of the year lemons which are left on the trees to become ripe are most susceptible to citrus brown-rot, readily becoming affected with it after harvesting.

To guard against brown-rot, Bordeaux mixture 3–4–50 should be applied, and whenever diseased fruits are found they should be collected and destroyed.

The season for harvesting Poorman oranges is now approaching. All fruits do not attain the yellow colouring at the same time, and this necessitates several pickings. All fruit should be handled carefully to prevent damage from bruising and from skin-punctures, which rapidly lead to decay. All stored fruit should be examined frequently, as decay is more prevalent than when the fruit is gathered under drier conditions.

L. Paynter, Orchard Instructor, Auckland.

POULTRY-KEEPING.

Preparations for New Season.

If the best results are to be secured during the coming season it is essential that the stock, plant, and equipment should be in good working order. The incubators and brooders should be examined carefully, special care being taken to see that they are in good order, for a defect such as a loosely fitting door has been the cause of many disappointing hatches, and perhaps a little attention to such a defect now may mean more and better chicks during the next few months. Repairs to fences, gates, doors, nests, feed-troughs, &c., if not attended to now, are likely to be left to cause much inconvenience and perhaps annoyance during the coming busy season.

The cleaning-up of the plant and the sweetening of the runs by digging them over and planting some quickly growing succulent green feed will all help to obtain the desired results, and if such work is done now the poultry-keeper will have more time later on to give to that important work of hatching and rearing the new flock.

It is wise always to have an extra feed-trough on a poultry-plant, and, in fact, a great number of poultry-keepers fail to appreciate the advantage of providing sufficient troughs so that all birds in a flock can feed at once in comfort. The greatest drawback in not providing plenty of trough-space is that at feeding-time some birds crowd on top of others in an endeavour to obtain sufficient feed, with the result that the strongest and largest birds secure the greatest amount, while the smaller birds often do not get sufficient: especially is this so if the feed provided is not as liberal as it should be, and if the growing stock are not graded according to size. It is not realized generally that lack of feeding-room is one of the reasons why at times so many birds of different sizes are seen in a flock of growing stock of the same age, and why so many pullets go into a false moult after having laid a few eggs. A good rule is to allow each laying pullet about 3 in. of trough-space.

Mating-time.

Generally speaking, August and September are looked upon as the best months of the year for hatching—August for the heavy and September for the light breeds—and therefore it should be the endeavour of all, both large and small producers, to have the required number of chickens hatched out before the end of September.

Though eggs may prove fertile from five to seven days after the stock have been mated, it is much more satisfactory to mate some time before the eggs are required, and there should be no delay now in doing this work. The breeding-hens should have been selected during February or March, but before mating them they should all be handled carefully and examined, firstly for insects, and if necessary treated, secondly for condition or for any signs showing want of vigour or constitution, for some hens that appeared to promise to be good breeders when selected during February or March do not come through the moult well, and lose condition, while others again put on too much condition and such birds are better out of the breeding-pen.

As the breeding-birds are the foundation of the poultry industry, the more care taken and knowledge shown in their selection the better. Purity of blood, vigour, and constitution, with capacity to produce and reproduce, are the chief things to look for.

The best and most promising specimens will show the following characteristics: Head fairly fine, showing strength and character; eyes bold, large, and prominent; face free from wrinkles and feathers; comb of medium size and thickness, but not coarse or flabby; wattles of medium size, fine, and close together; legs rather short, of flat bone, set well back and wide apart; well developed crop; deep, full abdomen, which should be soft and pliable to the touch (this is a very important point). The body should show length, depth, and width. A good width across the back is a character which specially should be sought in breeding. In general appearance, the good breeder's body will be of a wedge shape, not unlike that of a good milking-cow.

The aim of all poultry-keepers should be to breed birds of a uniform type, and in order to do this it is necessary to have some model to guide them. White Leghorn breeders would do well when selecting their Leghorn hens to take as a model the good White Leghorn breeding specimen as illustrated on page 50 of the Department's Bulletin No. 66, "Utility Poultry-keeping." This publication is procurable from the Publisher, Department of Agriculture, Wellington, price 1s. per copy, postage free.

The selection of the male bird is of great importance, as he leaves his influence on all the chickens—he is really more than half the flock and he should have come from parents of quality, of good robust constitution, and from a mother that produced eggs of good uniform shape, size, and colour, for the future stock can be expected to possess these very desirable qualities only when they have been inherited by the birds for generations.

Few, if any, birds in a flock are free of all faults, but in choosing the male it is advisable to see that he is strong where the hens are weak, or *vice versa*.

The production of small eggs is becoming a serious matter with some poultry-keepers, and the only way to correct this defect is to see that no hen goes into the breeding-pen unless she produces eggs of a good uniform shape, size, and colour.

As a rule a small bird lays small eggs, and, in fact, some poultry-keepers seem to favour the small hen and consider that a bird must be on the small side to be a good layer. This is a mistake, for smallness is really not the cause of great egg-production, but its effect. The general tendency is for the average size of the birds in a flock to get smaller each generation, and it is well therefore to watch this matter and select for the breeding-pen birds of a somewhat larger type than is usually found with the greatest egg-producers. The novice should always keep in mind the fact that if when selecting breeding-birds too much attention is paid to egg-production, and not sufficient notice given to the paramount importance of vigour and constitution, a heavy penalty will have to be paid sooner or later.

The feeding of the breeding-stock is an important matter, and the aim should be to feed in such a manner that the birds will be in the best condition to produce eggs containing the maximum amount of fertility and vitality. The birds should not be allowed to get too fat, but, at the same time, they must be kept in good condition although not forced for heavy egg-production.

There are many different systems of feeding breeders, and many successful poultry-keepers have their own method. The following system has been in use for a number of years, and is still being used successfully: When the breeders are selected in March, they are separated from the rest of the flock and fed on a grain mixture night and morning, the mixture being made up of (by measure) three parts wheat, one part barley, and one part yellow maize. This is fed in deep litter, and as much is given as the birds will clean up greedily. No mash is fed until about a month before the eggs are required for hatching purposes, when a mash is fed each morning (instead of grain) consisting of (by measure) two parts pollard, one part bran, three-quarter part of finely-cut succulent greenstuff, and 3 per cent. of the entire mixture of meat-meal, the lot being mixed fairly dry with skim-milk, and as much fed as the birds will clean up in fifteen minutes.

Oyster-shell and metal grit and clean water should be within reach of the birds at all times.

—*C. J. C. Cussen, Chief Poultry Instructor, Wellington.*

THE APIARY.

The Dormant Season.

DURING the months of June and July activities in the apiary, so far as the bees are concerned, should cease. No advantage is to be gained by interfering with the bees, provided that the colonies have been left with ample stores, that the queen is right, and that there is an adequate supply of mats to conserve the heat of the cluster. After heavy rains it is advisable to remove the roofs to ascertain the condition of the mats, and if any are found to be damp they should be removed. This can be done without disturbing the bees. Damp mats should not be tolerated, as they are harmful to the health of the bees at all seasons of the year, and more particularly during the winter months when dormant colony-conditions obtain. As advised previously, a plentiful supply of mats should always be on hand.

Moving of Bees.

Providing sufficient care is taken, bees may be moved long distances with perfect safety at this season. It is not advisable to delay this work until

the spring, as brood-rearing will then have commenced in earnest, and the numerical strength of the adult bees will be greater than at this period. Moreover, there is little brood in the hives to be injured. When moving bees short distances—*e.g.*, up to a couple of miles—little preparation is necessary beyond screening the entrance with wire gauze and fastening the bottom-boards and roofs with crate staples or battens. It is well to choose a cold night before closing the entrances of the hives to be removed. On arrival at the new location the bees should be allowed to settle down prior to removing the gauze. It is quite a good plan to place some obstruction—a piece of board will suffice—in front of the entrance, as this will cause the bees to investigate and take new bearings. Some such action is necessary to prevent the field-bees from returning to the old location.

When removing bees long distances, which may necessitate their confinement to the hives for a lengthy period, it is essential that they be well packed so as to allow of ample ventilation. To safeguard against suffocation of the bees the hives require to have wire screens top and bottom. The screens can be made by using narrow laths nailed together to form a frame of the same dimensions as a hive-body, and covering this with wire cloth. When placing the screens on the hives proceed as follows :—

The evening before removal, after the bees are all in, place a frame alongside each hive level-side up. Gently lift the hive on to the frame. Next remove the cover and mat, and place the upper frame level-side downward in position. The bees being now secure, the battens to hold the frames can be nailed on the following morning. Place a hive-cover over the frames in the event of rain falling during the night. When railing bees, the frames should run parallel with the truck, but with road transport the reverse should be the case. This rule should be followed to prevent the frames from rocking and thus killing the bees.

It is well to remember that, as a precaution against the spread of disease, bees should not be removed a distance of more than 10 chains without the written consent of an Inspector. Failure to obtain the necessary consent renders a person liable to a fine not exceeding £25.

The Winter Overhaul.

During the winter months, as opportunity offers, the working-plant of the apiary should be carefully overhauled. The engine, extractor, and tools should be examined, and defective or broken parts replaced, so as to have all in readiness for next season's work. It is not wise to leave the repairing and painting of spare roofs, hives, and bottom-boards until they are to be brought into use. Now is the best time to lay down future plans ; and if an increase in the number of colonies is decided upon, or the establishment of an out-apiary is being considered with the object of increasing income, no time should be lost in getting together the required number of extra hives, supers, roofs, and bottom-boards, and in the preparation of frames and the fitting of comb-foundation.

E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

Good seed, suitable manurial treatment of the land, and crop rotation are some of the main factors in the economical production of vegetable crops. Land that has been grazed for a number of years and has recently been well broken in will usually carry good crops, with ordinary attention, if good seed-strains are planted. After two or three years of intensive cropping, manurial treatment and rotation become of increasing importance. Organic as well as inorganic or artificial manures are then necessary to obtain good results. With thoughtful management good results may be obtained over a long period on heavy land ; but sometimes light land should be sown

down and grazed after a few years of cropping, so that it may regain its condition. This is necessary more particularly where organic manures are scarce.

Useful organic manures are farm and stable manure, fish and meat meal, blood and bone, poultry manure, and soot, seaweed, and plant growth of any kind that is free from serious diseases and that readily decays in the ground. Too often much of this valuable material is lying round in an untidy manner and is wasted by being dried and leached in sun and rain, after which even the residue is wasted. Stacked in a pit or on the surface of the ground, and covered with soil, it is in a few months sufficiently rotted for spreading on the land and ploughing under—where it is the indispensable basis of fertility, especially where continuous cropping is to be done. This treatment does not apply to fish and bone meal, which are dried and ground—a method which is also sometimes applied to poultry manure. Soot also is usually stored in a dry place under cover for a few months before use; and green cover crops are usually turned under where grown so soon as they commence to flower. But stock-manure of all kinds, especially where they have been bedded down with straw or bracken, weeds, and rough growth cut before seeding, seaweed, and any cheap organic refuse should be placed in the stack and fermented. Under good management in this climate, land of fair quality and condition, receiving a liberal dressing of this material during the winter every other year and artificial manures as required, will produce good crops under intensive culture for a long period.

The inorganic or artificial fertilizers, also organic manures such as bone and fish meal that are ground to a fine state of subdivision, are usually broadcasted on the land and worked in by cultivation two or three weeks before planting or sowing. More slowly acting fertilizers, such as basic slag, which is a useful form of phosphate for a change, especially on heavy land in a wet climate, and kainit, are applied in the early stages of the preparation of the land; while the more quickly acting manures, such as nitrate of soda, are withheld and usually applied as required when the plants are established. Lime is also an important factor in treatment, especially on heavy acid soils, where it is effective in producing the friable condition which is so desirable, and also assists the action of fertilizers. Some crops have a marked preference for the neutral or alkaline state of the soil, which may be obtained on acid soils by the use of lime. They include the cabbage and related plants, such as cauliflower, Brussel sprouts, radish, and turnips; also parsnips, beetroot, salsify; spinach, lettuce, asparagus, rhubarb; onions, peas, and beans. Ground carbonate of lime—that is, unburnt lime—is in general use, and if it is of good quality and very finely ground it is quite satisfactory. It may be applied at any time, but to best advantage in the early stages of the preparation of the land. On most of our heavy lands it is indispensable for this class of cropping, but on the lighter lands it must be used with judgment.

Most crops are heaviest when grown on land which has received a heavy dressing of organic manures during its preparation, but root crops of most kinds are coarse and unshapely when grown immediately after a heavy dressing of organic manure; hence crops must be classified and given the conditions that suit them. The use of lime is another reason for rotating crops. The diseases to which crops are liable vary, and as, in most instances, the land becomes contaminated, rotation of crops to a great extent avoids the perpetuation of disease. For these and other reasons a carefully thought-out system of cropping facilitates the work and gives greatly improved results.

Established crops of asparagus are dressed with manures in early spring and at the completion of the cutting-season. Besides a partiality for alkaline conditions, they thrive on nitrates and potash, which are the artificial manures of most importance. A reasonable amount of phosphates should also be included, and the humus-content of the soil must always be

maintained. A dressing of phosphates and potash may be broadcasted and disked in now, and two or three dressings of nitrate of soda applied during the months of August and September after growth has started.

Established crops of rhubarb require somewhat similar treatment. Nitrate of soda, 2 cwt. to the acre, may be applied after the first pulling in spring and another application when pulling has finished for the season; on heavy land sulphate of ammonia is a more suitable form in which to apply the nitrogen.

Seed-potatoes now require light and air, but should be protected from frost. With suitable light, air, and protection they produce short, strong sprouts and are in the best condition for planting. Any that produce spindle shoots or show other signs of disease should be discarded. Virus diseases are most prevalent in warm districts, and when stocks become seriously infected they should not be planted, but fresh certified seed obtained.

In the hands of a discreet cook garlic is a useful vegetable, and shallots are mild and tender and most suitable for pickling. Both may be planted now, when the land is in suitable condition; they produce heavy crops with little attention. It is seasonable to plant also cabbage and cauliflower and early potatoes if a warm spot is available. Old stools of rhubarb now may be cut into pieces with one or two good buds and planted with the point of the bud 2 in. deep. This is sometimes done later, after a moderate crop of sticks has been pulled. Sow radish, cress, lettuce, and spinach; broad beans, peas, and shorthorn carrots towards the end of July. If fresh stable manure is then obtained and prepared for a hot-bed it will be ready two or three weeks later for raising tomato and other half-hardy plants for setting out in October and November.

In the unheated glasshouse the tomato is planted out towards the end of July or August according to climate. The chief factors which produce a satisfactory crop are a clean house, well-prepared soil, and good plants. The first—a clean house—is best obtained by taking the matter in hand immediately a crop is finished: if modern methods are then thoroughly applied they will be found most efficient. The preparation of the land and raising the plants are the subjects now requiring most attention.

In not a few instances on heavy land the drainage is unsatisfactory, and good results rarely will be obtained under such conditions; better and earlier crops may be expected where this is rectified. Much has rightly been said regarding the injury caused to this crop by applying heavy dressings of stable manure and making the land rich in humus and nitrogen and causing the plants to be rank, unfruitful, and prone to disease. But on light land there easily may be too little humus, and even on heavy land humus is sometimes lacking where steaming is frequently practised. The very easy tendency to run to either extreme is to be carefully avoided; very good judgment is required in preparing land for any crop. Usually a green crop turned in every winter will keep the land sufficiently supplied with humus, or, in its absence, a dressing of stable manure every other season may meet the requirements. The tomato crop does not specially require a neutral or alkaline soil, but it is important that the soil be friable, and for that reason a dressing of finely-ground carbonate of lime is often an advantage. Such applications as have been mentioned should be applied early in the preparation of the soil, and two or three weeks before planting such artificial manures as may be required should be worked in. These usually consist of phosphates and potash: ¼ lb. fine bone-meal and 2 oz. each of superphosphate and sulphate of potash to the square yard is often found sufficient with liberal summer feeding after the fruit is set. If the land is rich in nitrogen a double application of potash would probably be an advantage for this crop.

In the absence of rainfall the land under glass is usually rather dry at this season, and a thorough watering is required two or three weeks before setting out the plants so that it may be in condition for this operation. Soil and subsoil should be thoroughly moistened, and it may take two or three applications of water to obtain this condition.

Good plants are of a suitable variety and strain and free from disease: usually the quality of the plants for this class of work is reasonably good. They should be taken into the house a day or two before planting, and, when the latter operation is done, set deep without drawing the soil round the neck of the plant, and, when the house is planted, settled in by an application of tepid water. Crowding is sometimes done with a view to getting a big crop, but this too often defeats its object: the tomato is partial to light and air—24 in. by 12 in. is as close as it is safe to plant tomatoes, and 30 in. between rows is more desirable, especially in humid localities. Some growers prefer to plant close and wide rows alternately: they may then be 21 in. and 27 in. respectively. A temperature of from 55° F. to 60° F. should be maintained at this stage, and it is well to avoid high temperatures during the day, which make the plants more susceptible when a low temperature has to be fought at night.

Small and Sundry Fruits.

Where small and sundry fruits are to be planted the preparation of the land should be continued without delay when the soil is sufficiently dry for working, as it is advisable that the soil settle with a well-graded surface before planting is done. Planting is done only under similar conditions, and it is important to set plants at the same depth as they were grown and to tread them in until they are quite firm in the ground. For strawberries especially should the land be firm with a well-graded surface. If the land is not quite clear of couch grass and other bad weeds, crops of this class should not be planted, but potatoes or other annual crops should be grown until the preparation in this respect is quite satisfactory. Drainage also is a matter with which it is unwise to temporize where these perennial crops are to be grown.

The Homestead Garden.

Success in horticulture depends chiefly on thoughtful planning and timely execution, for nature will take no excuses. New gardens are completed, or alterations are made in established gardens, during the autumn, the final operation being the planting of trees and shrubs at the end of that period. The only other opportunity of doing this satisfactorily is during the springtime, when lawns may be sown down about the month of August and planting completed about the month of September. Where work of this kind is to be done it should now be pushed along without delay in fine weather, as a reasonable period must be allowed in most instances for land to settle; or, as an alternative, the land may be consolidated with considerable labour. The best horticultural literature, which may be seen in most public libraries, contains many useful suggestions and clever plans for the home garden.

Many people with established gardens fail to realize the many opportunities for improvement which the present season affords. In most instances a few removals and additions in trees and shrubs would open up a view, screen unsightly objects, and add interest to a border. Or a plant border may be removed and grassed down and another cut and prepared elsewhere. In the garden, as in the forest, there is no finality, and the established garden can usually be gradually remodelled in any direction that is desirable.

W. C. Hyde, Horticulturist, Wellington.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

FEEDING-VALUE OF KARAKA BERRIES.

K. A. M., Ngapotiki :—

Could you give me any information regarding the feeding-value of karaka berries for sheep ? My lambs live largely on them for a period after weaning every year. This year the lambs are doing fairly well, and are in good condition, but do not grow much on berries, either in carcass or wool.

The Live-stock Division :—

The feeding-value of karaka berries for sheep has not been ascertained. At the same time it is safe to say that the fleshy part of the berries which is being eaten by your lambs has a composition very similar to that of any other berry and similar in many respects to that of the ordinary apple. Such fruits contain a high percentage of water, the dry matter being mainly composed of carbohydrates, the percentages of protein and fat both being low. As evidenced by the lack of growth in your lambs, it appears as if there is a deficiency of protein in the diet. The addition of a protein-rich concentrate such as linseed would assist materially in balancing the diet. The kernel of the berry which contains the poisonous properties is apparently not being eaten by the lambs.

EFFECT OF RAGWORT IN SILAGE.

F. J. E., Bulls :—

Some say that whilst a certain amount of ragwort in hay is not injurious to cattle, as they decline to eat it, this is not so with silage as they cannot then separate the ragwort from the remainder of the silage. Does ensiling destroy the poison in the ragwort ? If there is danger the remedy would appear to be to cut the grass early in the season before the ragwort reaches the flowering stage, which is held to be when it becomes dangerous.

The Fields Division :—

In the case of hay containing ragwort stock discriminate and generally sort out most of the ragwort, leaving it behind unconsumed. To some extent the same occurs in feeding silage containing ragwort, but naturally it is much more difficult for stock to discard ragwort from silage. In one instance silage containing upwards of 20 per cent. of ragwort was fed to guinea-pigs at the Wallaceville Laboratory without any ill effects, and, in consequence, similar silage was subsequently fed to a herd of dairy cows in Taranaki without any bad effects. In this instance it was observed that the cows were inclined to discard as much of the ragwort as possible, and on this account the owner was advised to allow the animals a liberal ration so that they would be encouraged as much as possible to leave the ragwort unconsumed. The bad effect on stock from eating ragwort is more or less cumulative. There is no evidence that young ragwort is less dangerous than ragwort in seed-head. As prevention is always better than cure, every endeavour should be made to eradicate or at least lessen the amount of ragwort by the use of sodium chlorate.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 16th May, 1935, to 30th May, 1935, include the following of agricultural interest :—

No. 72686 : Latch for door in cow-bail ; H. E. Wills. No. 72824 : Spraying-machine ; J. Gilmour. No. 73679 : Dry-cleaning eggs ; A. Davidson. No. 73680 : Destruction of pest ; Hart and Co. Pty., Ltd. No. 73697 : Cooler ; J. R. Miller. No. 72119 : Leg-holder for cow ; A. C. Beer. No. 72219 : Cheese-manufacture ; W. H. Udy and W. C. Dixon. No. 72311 : Tine-harrow ; J. A. Thorne. No. 72742 : Vat-cover ; A. E. Denham. No. 73161 : Fencing-post ; A. M. Blackler. No. 73724 : Churn and butter-worker ; Challenge Cream and Butter Association.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s., prepaid.

WEATHER RECORDS: MAY, 1935.

Dominion Meteorological Office.

NOTES FOR MAY.

DURING May there were two periods when fine and mild weather prevailed generally—namely, between the 11th and 15th and from the 25th to the 27th, but the remainder of the month was mostly cold and unsettled, with a predominance of southerly winds. Owing, however, to a particularly favourable autumn, and also to the two mild periods above referred to, there was a good growth of pasture, and generally a plentiful supply of winter feed appears available. Consequently, stock kept in good condition, although the cold spells experienced detrimentally affected the milk-yield and there were also some small losses of sheep.

Temperatures.—Whereas in the preceding six months temperatures were above normal over the greater part of the Dominion, during May there was a definite change to wintry conditions, and, except in the far North, temperatures were everywhere below normal, the largest difference being in eastern areas, where they ranged between 1 and 2 degrees below.

Rainfall.—Rainfall was below the average in parts of the Auckland Province and in the east coast areas between East Cape and Otago, but over the remainder of the Dominion it was above, the excess being greatest on the west coast of the South Island and in the Wairarapa.

Sunshine.—On the other hand, sunshine was generally below normal in eastern districts and above in western, although totals did not differ greatly from May averages. Tauranga registered 183 hours bright sunshine, Nelson 169, Blenheim 163, and New Plymouth 159 hours.

Storm Systems.—On the 1st an unusually deep depression moved on to the Dominion, its centre crossing the southern districts during the night. Pressure remained low to the eastward, however, until the 9th, while an intense anticyclone was moving very slowly across the Tasman Sea. Consequently, throughout this period cold southerly winds persisted, reaching gale force in many places.

Between the 4th and 6th conditions were particularly boisterous, a southerly gale being accompanied at times by heavy hail and sleet showers. On the 5th there were heavy snowfalls on the ranges of both Islands, and a considerable amount also occurred on the low country. In Taranaki as much as 2 in. fell on the flat in places where snow so early in the winter is almost unprecedented.

By the 9th the front of an anticyclone had moved on to New Zealand, and then followed several days' fine weather.

From the 16th to the 21st a series of intense westerly depressions crossed the Dominion, and strong and squally north to west winds prevailed. Rainfall at this time was confined chiefly to western districts, where some heavy falls caused floods in the rivers, particularly in Westland, on the 18th and 19th. On the morning of the 20th a violent north-westerly gale which swept Canterbury caused widespread damage.

During the night of the 21st the last of this series of depressions crossed the Dominion, and another southerly storm swept the country, accompanied by bitterly cold weather. Severe thunderstorms occurred in the Taranaki and Wellington districts on the 21st, and heavy rain and floods were experienced in many parts of these areas. The southerly continued to be strong in the central districts during the 22nd and 23rd. The Wanganui district experienced a severe gale on the morning of the latter day.

From the 24th until the 28th the weather was fine and quiet, with high pressure ruling. A cyclonic depression was, however, moving from the North down the west coast, and from the latter date until the end of the month dull, misty weather prevailed. Fairly general rain fell during the night of the 28th.

RAINFALL FOR MAY, 1935, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.	Total Rainfall to Date.	Average Rainfall to Date.
	North Island.					
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	5·78	21	1·30	6·61	28·39	21·56
Russell	8·34	16	1·72	7·07	45·55	20·84
Whangarei	4·93	20	1·20	7·88	32·36	25·06
Auckland	4·24	15	0·75	5·15	25·55	18·84
Hamilton	..	..	..	4·70	..	18·79
Rotorua	4·03	19	0·93	5·69	28·44	21·62
Kawhia	..	..	..	5·34	..	19·82
New Plymouth ..	7·55	17	1·59	6·20	34·09	22·59
Riversdale, Inglewood ..	11·43	17	2·41	9·69	52·23	38·38
Whangamomona ..	..	..	..	6·84	..	27·81
Hawera	4·94	12	1·25	4·58	25·99	16·98
Tairua	3·88	13	1·04	7·08	32·78	26·59
Tauranga	4·88	17	1·49	5·10	27·91	21·53
Maraehako Station, Opotiki	9·04	15	4·20	5·70	36·03	22·13
Gisborne	3·39	18	0·91	5·36	18·06	20·01
Taupo	3·99	17	1·00	3·95	22·47	16·80
Napier	2·55	14	1·50	3·18	19·41	13·16
Hastings	1·84	15	1·03	3·29	16·01	13·56
Whakarara Station ..	3·38	12	1·92	..	24·74	..
Taihape	4·68	19	1·34	3·46	15·98	14·43
Masterton	6·71	22	3·40	4·04	14·15	15·18
Patea	6·10	13	1·54	4·15	24·34	17·16
Wanganui	4·26	12	0·91	3·34	19·64	14·33
Foxton	4·93	15	1·76	3·19	14·52	11·88
Wellington	3·50	19	0·61	4·10	14·35	16·58
	South Island.					
Westport	10·17	19	2·13	8·35	40·71	37·65
Greymouth	11·78	18	1·86	8·10	47·40	40·76
Hokitika	13·87	16	2·44	9·58	59·52	45·87
Ross	16·88	15	2·96	9·83	57·44	54·04
Arthur's Pass ..	19·19	10	5·60	12·78	73·61	65·41
Okuru, South Westland	10·35	8	3·95	10·80	59·74	61·32
Collingwood	16·53	16	5·37	8·87	42·36	34·80
Nelson	3·66	14	1·96	3·26	21·31	14·81
Spring Creek, Blenheim	3·41	11	1·43	3·03	11·92	11·53
Seddon	..	..	..	2·83	..	10·23
Hanmer Springs ..	4·92	15	0·73	4·54	15·48	18·38
Highfield, Waiau ..	1·66	6	0·72	3·25	10·04	14·27
Gore Bay	1·25	14	0·22	3·41	8·70	13·18
Christchurch	4·01	14	1·49	2·62	8·44	10·10
Timaru	0·95	8	0·37	1·48	8·94	9·39
Lambrook Station, Fairlie	..	..	..	1·57	..	10·12
Benmore Station, Clearburn	2·01	14	0·45	1·79	12·43	10·99
Oamaru	1·35	12	0·45	1·60	9·52	9·00
Queenstown	3·42	16	0·98	2·59	17·23	13·13
Clyde	0·99	9	0·25	0·99	8·22	6·84
Dunedin	4·01	18	0·66	3·10	16·74	14·94
Wendon	3·52	17	0·59	1·98	17·60	12·89
Balclutha	2·93	12	0·49	1·92	15·26	10·72
Invercargill	4·71	20	1·14	4·36	23·80	19·67
Puysegur Point ..	7·63	20	0·87	6·67	38·19	35·67
Half-moon Bay ..	4·76	22	1·29	4·85	24·77	24·22